SCIENTIFIC AMERICAN

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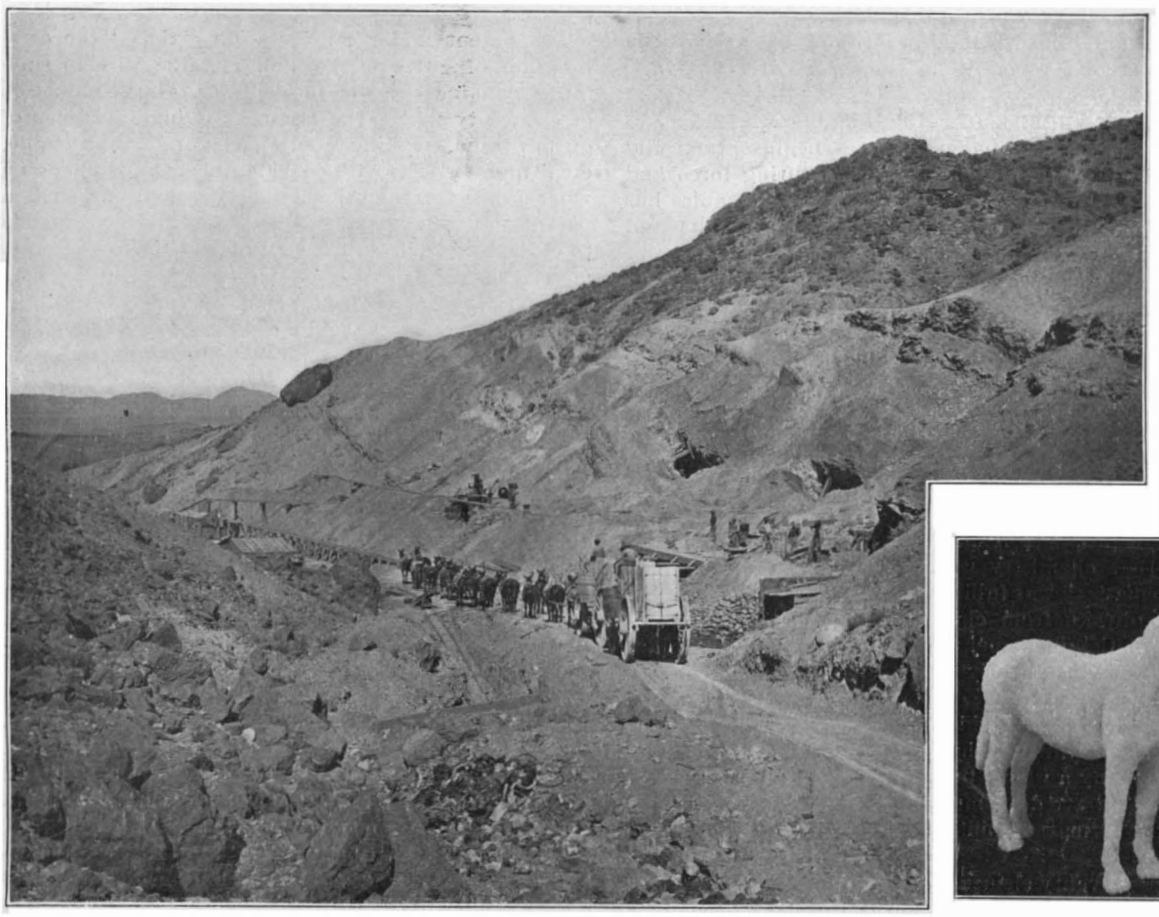
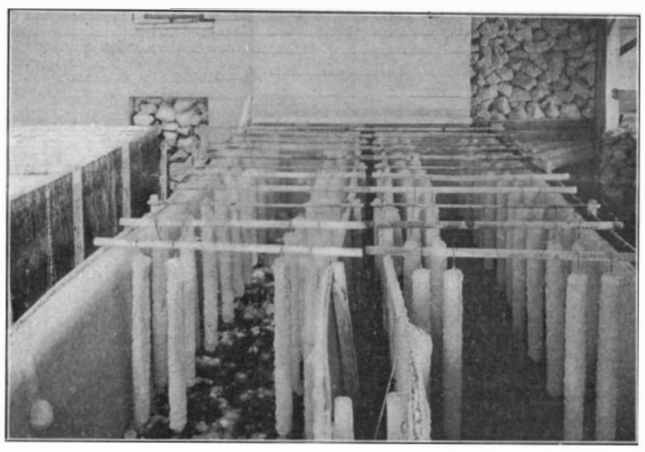
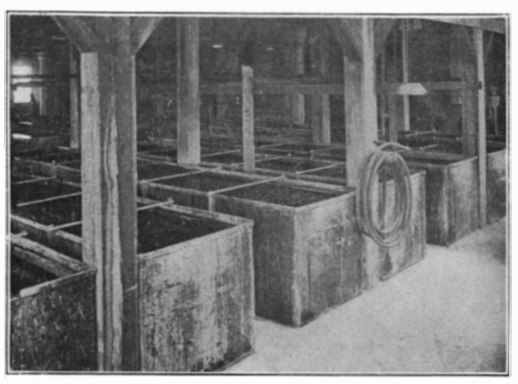


Borate Mines in San Bernardino County, Cal.

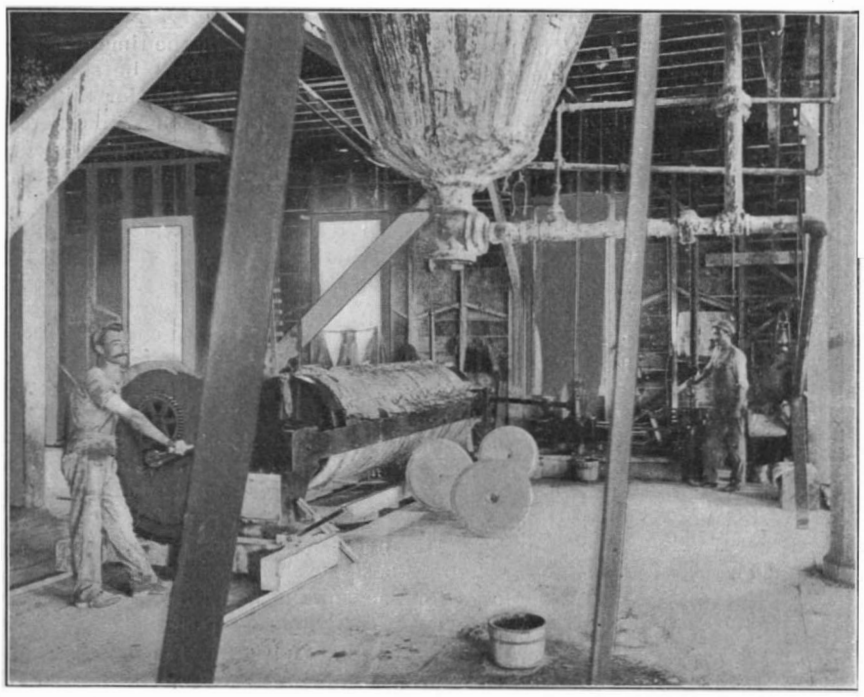


The Crystallized Borax on the Rods.

A Borax Mule.



Tanks Dissolving the Borate of Lime



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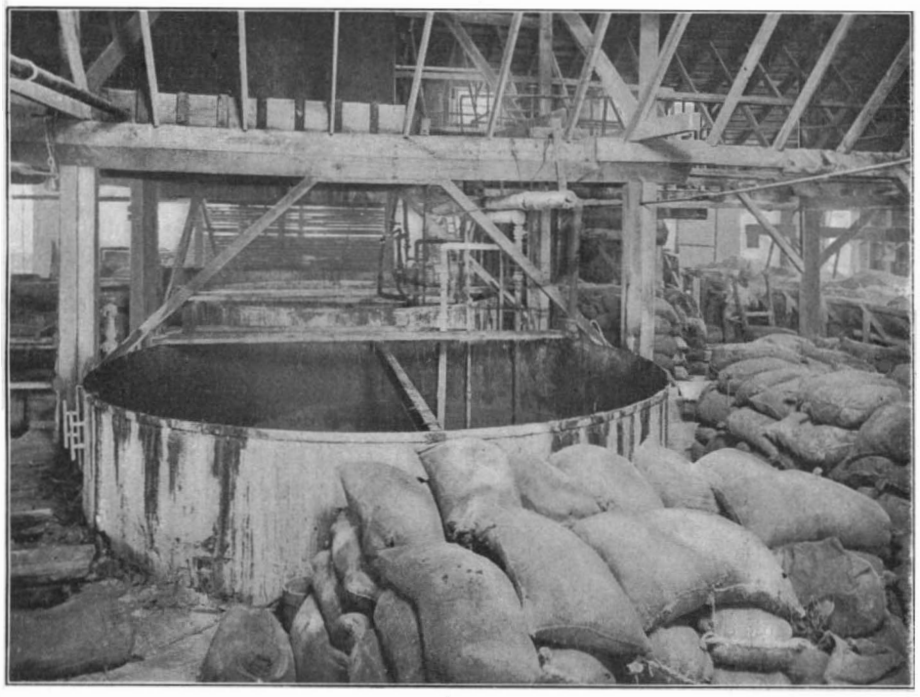
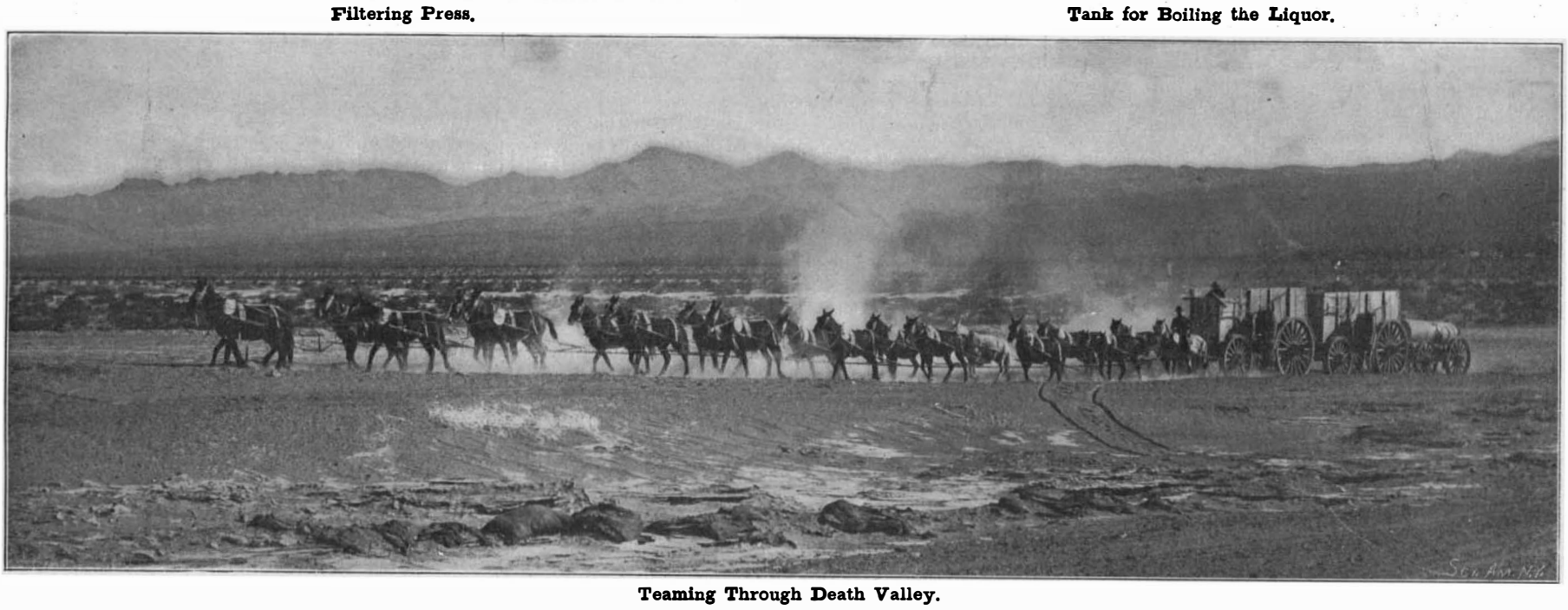
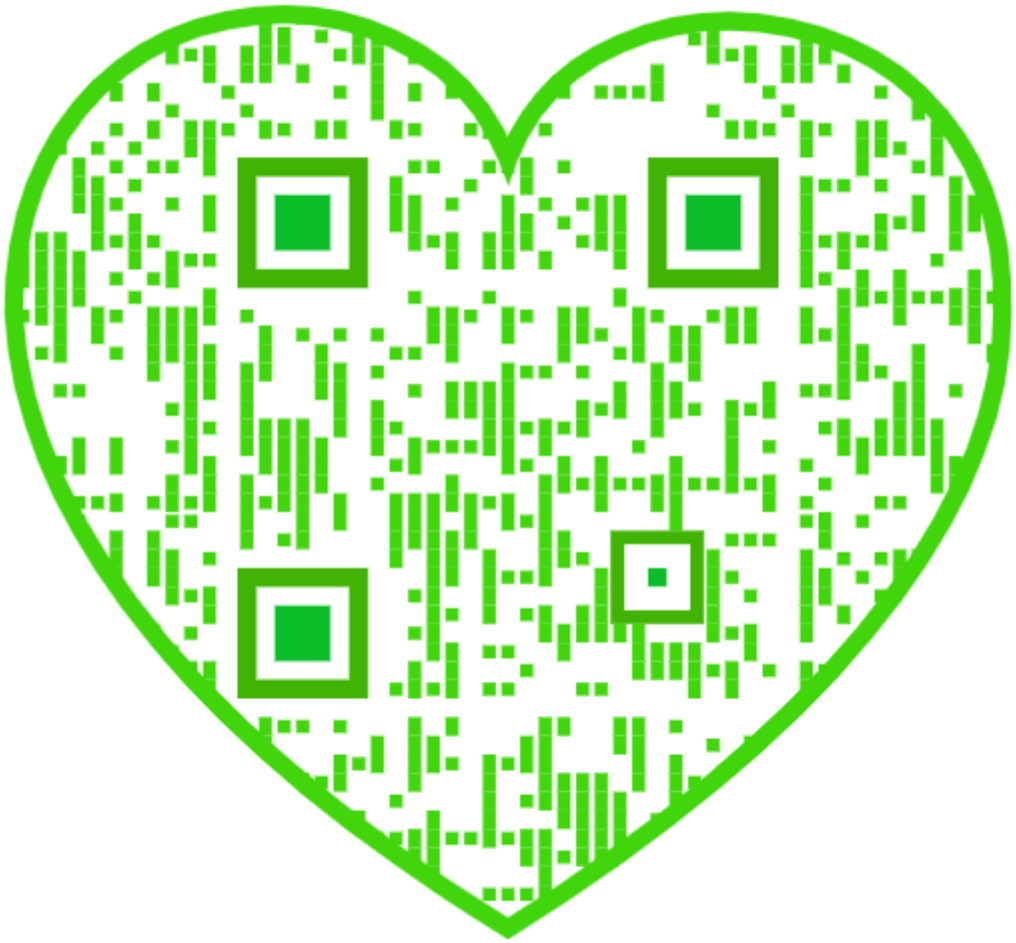


Tank for Boiling the Liquor.



Teaming Through Death Valley.

THE CALIFORNIA BORAX INDUSTRY.—[See page 326.]



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NEW YORK, SATURDAY, MAY 26, 1900.

PROGRESS OF THE NEW YORK RAPID TRANSIT TUNNEL.

Although several weeks have passed since the letting of the contract for the construction of the rapid transit tunnel in this city, it was only on Monday, May 14, that the actual excavation of the tunnel was commenced. If we bear in mind that this contract is by far the most costly of the kind that has ever been let to a single contractor, involving as it does the expenditure of $35,000.000, and that the whole twenty miles of the work had to be divided into sections, and a selection made of the most reliable and capable from scores of would-be sub-contractors, the present status of the work may be considered as satisfactory.

At the present writing sub-contracts have been let for practically the whole of the road, the section between Thirty-third and Eighty-fourth Streets being still under consideration. The first two contracts to be let covered the important preliminary work of lowering the Bleecker Street sewer and diverting the great sewer at Canal Street, which is being prosecuted as rapidly as the necessities of street traffic will allow. At Bleecker Street the sewer is to be lowered some twenty feet to clear the floor of the tunnel, while at Canal Street it will be necessary to build practically a new sewer. Here the present flow is toward the Hudson River, but as soon as the new work is completed, the sewage will be discharged easterly into the East River.

Although the formal inauguration of work took place on March 24, in front of the City Hall, when the first spadeful of earth was turned by the present Mayor, there will be no actual excavation at the site marked by the commemoration tablet. The spot chosen for the function of May 14 was at One Hundred and Fifty-sixth Street, where the first actual digging of the tunnel is taking place. This particular section, which extends from One Hundred and Fifty-fifth to One Hundred and Sixty-second Street, will be excavated by what is known as the "cut and cover" method; that is to say, an open cut will be made, in which the steel-and-concrete floor, sides, and roof of the tunnel proper will be built, the material being subsequently filled in and the roadway restored to its former condition. The greater part of the excavated road will be built on this system, there being only about three and a half miles of straight rock tunneling.

The location of the road with regard to the surface and the nature of the material encountered is such that, contrary to the popular expectation, there will be no use made of the shield which has figured so largely in the Thames tunnel and the various London underground railways. These roads are being constructed at a considerable depth below street grade, and largely in a bed of clay which lends itself admirably to the use of the shield. In the New York subway, on the other hand, wherever the road lies too deep for cut and cover work, the material is chiefly solid rock and the use of the shield is not necessary. Even where the east side branch of the road passes beneath the Harlem River, it is estimated that it will be more economical to construct the tunnel by sinking caissons—the short distance, about 400 feet, beneath the river, not warranting the expense of sinking and driving a costly shield.

The methods of construction used on the successive sections of the tunnel will be as follows: Cut and cover from the present terminus at City Hall Park to Thirty-third Street; tunnel from Thirty-third to Forty-first Street; cut and cover from Forty-first to One Hundred and Fiftieth Street, except the viaduct over Manhattanville and a short length of tunnel at One Hundred and Twentieth Street; tunnel from One Hundred and Fiftieth to One Hundred and Fifty-fifth Street; cut and cover to One Hundred and Sixty-second Street, and tunnel to Fort George at about One Hundred and Ninety-fifth Street. On the east side branch there will be tunnel construction from One Hundred and Fourth to One Hundred and Tenth Street; cut and cover to a point across the Harlem River at Girard Avenue; tunnel to Third Avenue; and elevated structure from Third Avenue to Bronx Park.

It is very gratifying to note the unanimous favor with which the proposal to extend the tunnel to South Ferry and beneath the East River to Brooklyn has been received. The necessary surveys for the extension to the ferry were made some years ago, and the surveys for the tunnel beneath the river are now under way.

From this brief survey of the situation, it is evident that before the next century is five years old, New York will be possessed of a completely new system of transit, which in location, capacity and speed will be unsurpassed in any city of the world. With its easy accessibility, ample ventilation, and the thoroughly up-to-date electrical equipment that will be put in, we are sanguine that it will meet all the high expectations to which it has given rise in the people of this city.

SOME NEEDS OF MODERN CHEMISTRY.

Our modern system of mechanics begins practically with the invention of means for measuring force and for calculating its effect upon matter. Mechanics has not alone profited by the labors of Helmholtz and Maxwell, Robert Mayer and Joule; the achievements of these physicists were also the means of elevating chemistry to the rank of an exact science. Chemists were compelled to retrace their steps, to re-explore fields which they thought had been thoroughly investigated, and to study old processes in the light of the new discoveries. The laboratory investigator was no longer content to measure only the matter at his disposal; he found it necessary to know how great was the force released or rendered latent by chemical processes. Thus it was that thermochemistry originated; and thus the prophecy made by Richter one hundred years ago, that chemistry was but "a branch of applied mathematics" was fulfilled. The gap that once separated physics from chemistry is now bridged. Our study of the phenomena of dissociation and of dissolution, carries us directly into the province of molecular physics.

But great as the strides have been which chemistry has made within the last half century, there still remains many a weary path to be pursued. Although physicists have done much to clarify the chemist's conception of matter and force, they have not told him all.

Those seventy elements which are daily used in the laboratory, surely they are but the variant forms of a single matter. We have but one force; and why should there be seventy matters? That wonderful periodical law, with its puzzling numbers, seems to contain within it the means of discovering the primeval matter for which chemists have long been seeking. The old alchemist with his theory of the transmutation of elements again lives; but he is now a chemical physicist, who endeavors not to convert a base metal into gold, but to prove the existence of one form of matter.

The mysteries of chemical energy are also still to be unfathomed. The forces which we have learned to observe and to measure are phenomena of a secondary nature. The chemical energy whose transformations give rise to these forces is still a puzzle to chemists. Instruments of measurement can reveal only the sum total of this energy, but not the nature of the intramolecular changes which occur. For this reason we have no clear conception or numerical expression for the relation of chemical energy to other forces; in other words, we have no chemical equivalent of work. We know that chemical energy is converted not only into heat, but also into light and electricity. That a chemical work can be directly transformed into motion seems also probable.

It cannot be for a moment doubted that the problem of chemical energy and matter will eventually be solved. When adequate laws shall have been formulated by the twentieth century investigator, we may possibly speak of a "mechanical" or "kinetic" chemistry, which will be added to the list of exact sciences.

TWO IMPOSSIBLE BILLS.

There is a certain sense in which it is true that none of the bills presented for the consideration of Congress are so dangerous as those that are obviously impossible and silly. A vicious bill, or one that carries its condemnation visibly written across its face, if it possesses but one favorable feature, is likely to receive sufficient debate to insure its defeat; but there is always a danger of the absolutely ridiculous measure slipping through Congress because of the very contempt and neglect with which it is received.

In the latter class belongs Representative Chanler's bill to grant an extension of seven years to a patent for insulating submarine cables, which was originally granted on the twenty-first of May, eighteen hundred and sixty-seven to one George B. Simpson, and, therefore, has now been an expired patent for over sixteen years.

Under the law which was in force until the year 1861, all patents expired at the end of fourteen years, with the privilege of renewal for seven years if the patentee could show that the difficulties, delays and costs of developing his patent had been so great as to prevent him from realizing within the fourteen years a reasonable profit from his invention. Under the law which went into effect on March, 1861, the life of a patent was extended to seventeen years, that being considered an ample period of time to cover all possible delays in developing the patent, and allow of its subsequent profitable operation. The Commissioner of Patents cannot grant an extension except under a special act of Congress, and it is understood that only on most exceptional grounds will a petition for extension be entertained, the period of seventeen years being considered as a generous grant, and one that is just to the interests both of the inventor and the public.

The patent under consideration claims "the combination of gutta-percha and metallic wire in such forms as to incase a wire or wires, or other conductors of electricity within the non-conducting substance of gutta-percha, making a submarine telegraph cable, etc.," and one asks with considerable astonishment on what grounds renewal should be asked for such a patent. It surely cannot be that seventeen years was too brief a time in which to put into practical commercial shape the simple device which forms the subject of the claim, and as far as its commercial aspect is concerned, the gutta-percha covered conductor is suggestive, in the period covered by the patent, rather of ample profits than of the struggling and poverty-stricken inventor. The only suggestion of a motive for the preferring of this extraordinary request is found in the last provision of the bill, "that the benefits accruing from the use of said patent shall inure solely to the heirs of the widow." Possibly there is a motive of philanthropy behind this measure; but in any case we are certain that Congress will require something stronger than sentimental reasons before renewing a patent on a gutta-percha covered conductor.

The zeal of Representative Chanler for his constituents is quite eclipsed by that of Representative Underhill, who has introduced a bill for the extension for seven years of a patent that has yet three years to run. The patent is for an improvement in analytical balances. It would be interesting to know what are the special conditions which enable Representative Underhill to determine, three years before a patent has expired, that its owner is entitled to seven more years of protection than are granted to the thousands of contemporary applicants at the patent office.

THE POSTAL SERVICE IN THE TIME OF QUEEN ANNE.

The postal service in England in the time of Queen Anne was not as rudimentary as might be supposed. There were six great offices in London for taking in letters, and there were 600 smaller ones in different parts of London for the convenience of correspondents. The penny post was started in 1683 by an upholsterer named Murray. The service seems to have been an excellent one, and even bundles weighing a pound could be sent, provided that the bundle was not worth more than ten shillings.

Articles of value could be sent if an account of them was given at the office. In 1711 an act was passed abolishing the penny post. They were taxed with the rates and stamped with the mark of the general post office and the rate was 1 shilling per ounce for parcels. Letters could be carried 80 miles for two pence; letters more than 80 miles, three pence and six pence. A letter to Dublin cost six pence single, and double letters one shilling, and one shilling and six pence an ounce. Foreign postage was not very expensive. In 1705, for instance, a letter of a single sheet could be carried to the West Indies for one shilling and three pence, and in 1708 Mr. Povey established a foot post carrying letters in the London district only, for half a penny; it was not long, however, before the postal authorities stopped him.

TEXTILE MANUFACTURING IN THE NEW SOUTH.

BY J. A. STEWART.

The growth and development of the South in industrial enterprise during the past decade has been phenomenal, and its advancement in textile industries must be regarded as a natural and a national development. The South, it stands to reason, should be particularly interested in everything pertaining to the growth of cotton and in cotton products. As the chief source of the world's supply of raw cotton, the southern section of the United States has held a unique and distinctive place. It looks now as if it would also earn prestige as a cotton manufacturing stronghold. Though the South built its first cotton mill about the same year in which Samuel Slater laid the foundations of New England's magnificent textile industry, no noticeable advance was made until recently. Now South Carolina ranks second only to Massachusetts in the number of her spindles. North Carolina contains more factories than South Carolina, though her plants average smaller, and Georgia and Alabama are rapidly following the lead of the Carolinas.

There are two chief advantages in the South for cotton manufacturing: Proximity to the sources of supply of raw material and an abundance of cheap labor,

The value of these requisites to successful industrial enterprise needs no exposition. In addition to these prime advantages, are claimed cheap mill sites, low taxes, cheap building material, cheap fuel, a low rate of living expenses, and present freedom from labor agitation.

It is the tardy, but now general, recognition of these economic advantages which has brought about the present general awakening of industrial movements in the South. The growth has largely taken place within the past five years. In textile manufacturing, as has been indicated, the gain is prodigious. While there were 7,160,000 spindles in Massachusetts at the beginning of 1895, there was no State south of Mason and Dixon's line with 1,000,000. In 1898 both of the Carolinas had over one million apiece, with Georgia close behind. From 1896 to 1898 the number of spindles in Massachusetts had increased only 1½ per cent.; but South Carolina had made a gain of 26 per cent. In Alabama the increase in the number of spindles for the same time was 36 per cent.; Kentucky, 17·35 per cent.; Arkansas, 16·43 per cent.; and North Carolina, 13·12 per cent. The increase in both the Carolinas for the decade ending 1896 was over 300 per cent. During the current year mills are being rapidly erected and the development continues on a colossal scale. It is estimated that the increase in the price of raw cotton to nearly 10 cents a pound had added almost $200,000,000 to the available wealth of the Southern people in a single season. It is evident that this accretion of wealth demands investment. The Southern capitalists are putting their money into new factories as the best possible outlet for surplus capital. It has been stated that every Southern cotton mill is making over 15 per cent. on its capital. In many cases, it is declared, the profits for 1899 ran up to 75 per cent., and there is a certainty that this prosperity will be exceeded during the present year.

Perhaps in no section has the Southern movement been viewed with livelier interest than in New England, the citadel of the cotton industry. In the large cotton centers of Massachusetts and Maine, the manufacturers have claimed that a reduction in wages was necessary to enable them to make goods in competition with the low wages and long hours in the South. In New England nearly uniform laws respecting hours of labor and employment of children make the conditions more equal in the competition of these States.

However, although a healthful competition may arise, no serious antagonism is anticipated between the industrial interests of the North and South. The outcome will undoubtedly simply be that the entrance of the South into the arena of cotton manufacturing will bring about a readjustment of producing centers. It is aptly pointed out that as our textile manufacturing grows, it is fast becoming separated into distinct classes, each class starting about some special place. Thus Fall River leads in the manufacture of prints. Providence is the center of the worsted industry. New Bedford sets the standard in finer white cottons, and Lowell in coarser goods. New England as a whole is coming year by year to finer counts. As long as no other part of the United States was engaged in manufacturing coarser goods, New England retained her grasp in that field, leaving the finer makes to foreign looms. But each year sees a finer product from New England looms. Climatic advantages over the South in the way of the essential degree of humidity will always be in favor of New England. This fact seems to relegate to the South the coarser products, for which humidity is not so necessary. The rapid perfecting of humidifying apparatus, however, is miminizing to some extent the climatic disadvantage of the South.

The commercial interests of the North and the South are too interrelated to become antagonistic. The Southern mills are wisely welcomed by the broad minded New England manufacturers as notable additions to American industries. The Southern movement is providing a direct stimulus to national production. It is working primarly as a lever in educational progress in promoting schools for training textile workers and skilled craftsmen and designers to produce the finer and more valuable products which will in the future more and more constitute the output of Northern looms.

If no other proof were at hand to show the advance of cotton manufactures there, the consumption of cotton in the Southern States would reveal the fact. In 1891-2, 686,080 bales of cotton were used in Southern mills. In 1894-5 this amount had increased to 862,838 bales. In 1898-9 to 1,413,928 bales. North and South Carolina are now using 50 per cent. of their cotton product. The 75,000 spindles in operation at Columbus, Ga., have just been increased to 100,000 and the 30,000 bales of cotton required to 60,000 bales. Local mill men are thus displacing the dealers, and what has been successfully accomplished in the Carolinas is rapidly becoming a fact in Georgia as well. With the growth of manufacturing and consequent increase in the consumption of raw material will come the demand for greater production of cotton. It is well held that the South could produce two bales of cotton for every one now marketed. The real relief to the over-supply of cotton products would, of course, come from the opening of foreign markets. Commercial expansion is in the air. Our export trade already shows the trend in this direction. The increase of manufactures is fifty million dollars greater for 1899 than the amount for the corresponding months in 1898.

Attention is called to the fact by a recent writer that only one-third of the cotton grown in the United States (which in 1898 reached 10,000,000 bales), has hitherto been used in this country. The other two-thirds has been shipped to England, Germany, France, Russia, India, Japan and other countries. We have been shipping three billion pounds of raw cotton at from 5 to 7 cents a pound when we might have exported manufactured products worth 15 to 25 cents a pound. The British exports of cotton goods in 1896, aggregated 5,218,248,600 yards in a year. American exports were only 281,211,521 yards. The query naturally is suggested, "Why may we not hope to manufacture our entire cotton product and export only manufactured product?"

It is evident to the thoughtful onlooker that the rapid development of textile manufacturing in the South does not necessarily involve its decrease in New England or in Great Britain. The ever-growing demands of the world furnish new industrial marts to conquer. And industrial progress in the South can only be regarded with satisfaction in view of the emancipation it is calculated to bring to that section through the nobility of well-requited labor.

THE HEAVENS IN JUNE.

BY HENRY NORRIS RUSSELL, A.M.

June, as well as May, is favored with an eclipse visible in America, but it is one of far less importance than its predecessor. While on May 28 the moon interposed itself exactly between the earth and the sun, on June 12 the earth is so far out of the direct line joining the sun and moon that only $\frac{1}{1000}$ of the moon's diameter falls within the shadow. Since, however, the earth hides most of the sun from parts of the moon near the shadow's edge, the darkening of the moon's southern limb by the penumbra will be easily seen, though it will require instrumental means to detect the tiny notch in the limb, due to the true shadow.

The circumstances of the eclipse are:

Moon enters penumbra	June 12,	8:15 P. M.	Eastern	standard time.
Moon enters shadow	"	10:24 P. M.	"	"
Moon leaves shadow	"	10:31 P. M.	"	"
Moon leaves penumbra	June 13,	12:17 A. M.	"	"

The earlier part of the eclipse is therefore visible only in the East, as in the West the moon has not risen.

THE HEAVENS.

The Milky Way, inconspicuous for the last few months, has returned to the eastern sky by the middle of June. Along its course lie several of the most easily recognized of the stars and constellations in sight—the irregular W of Cassiopeia in the north, the cross of Cygnus in the northeast, Altair, marked by a smaller star on each side, in the east, and Scorpio in the south, identified by the fiery Antares, and the long curved stream of stars sweeping southward and forming the tail of the monster. West of the Galaxy, near Cygnus, is the brilliant Vega, and about as far from the zenith on the opposite side shines Arcturus. Ursa Major, Leo and Virgo are the most conspicuous ornaments of the western sky.

Vega, Arcturus and Antares offer a striking contrast in color, the first being white with a strong tinge of blue, the second yellow and the third red. This difference, beautiful as it is to the eye, becomes far more impressive to the mind when we know that these three stars are good examples of the three classes into which the spectroscope divides the vast majority of all stars observed, and that there is good reason to believe that they represent three different degrees of stellar temperature—the white stars, as might be expected, being hottest, the yellow intermediate, and the red coolest. So these three stars present to us at a glance types of three stages in the life history of a sun—displaying at one time conditions separted by countless ages in the gradual cooling down (or perhaps warming up) of a single star.

THE PLANETS.

Mercury is evening star throughout June, but is too near the sun to be seen in the early part of the month. It travels rapidly eastward among the stars, passing from Taurus through Gemini into Cancer, and at the end of the month is easily visible in the evening twilight, setting about an hour and three-quarters after sunset.

Venus is also an evening star in Gemini, approaching the sun all through the month, and losing brightness as its crescent becomes narrower, in spite of its steady approach toward the earth. On the 21st it is in conjunction with Mercury, being a little over 2° distant, and affording a particularly good opportunity for those unfamiliar with the latter planet to recognize it. By the end of the month Venus sets less than an hour later than the sun, and is no longer conspicuous.

Mars is morning star in Aries and Taurus, rising about two hours earlier than the sun, but is still faint and distant.

Jupiter has just passed opposition and is by far the most conspicuous object in the Southern sky. His satellites are easily seen with a field-glass, especially if its power has been doubled by placing both the concave eye-lenses in the same tube, (which must usually be lengthened with cardboard to allow for the change of focus). With such an arrangement the crescent form of Venus, the disk and satellites of Jupiter, and the elliptical outline of the ring of Saturn may all be seen, as well as the larger craters of the moon.

The study of the motions of Jupiter's satellites from night to night is interesting. The two inner ones move so fast that it is difficult to identify them without reference to the figures given in the Nautical Almanac. The third satellite which is the brightest of the four, will be east of the planet on the 2d, 9th, 16th and 23d and west on the 5th, 13th, 20th and 27th. The fourth and most distant reaches its eastern elongation on the 3d and 20th and its western on the 12th and 28th.

Saturn is in Sagittarius, rising about 9 P.M., on the 1st and 7 P.M. on the 30th. It is in opposition on the 23d, and the northern side of its rings is seen at as favorable an angle as possible, but it is so far south that the time during which it is far enough above the horizon to be observed is shorter than usual.

Uranus is in Scorpio, about 4½° north and 2½° east of Antares, and is barely visible to the unaided eye. Neptune is in Taurus. It is in conjunction with the sun on the 17th and is too close to it throughout the month to be seen.

THE MOON.

First quarter occurs on the night of the 4th, full moon at the time of the eclipse on the 12th, last quarter on the evening of the 19th, and new moon on that of the 26th.

The moon is farthest from the earth on the afternoon of the 5th, and nearest on the evening of the 18th. It is in conjunction with Jupiter on the afternoon of the 11th, with Uranus the same night, with Saturn on the afternoon of the 13th, when an occultation is visible in Europe, with Mars on the morning of the 24th, with Neptune on that of the 26th, and with Venus and Mercury early on the mornings of the 28th and 29th respectively.

Comment on the results of observation of the total eclipse is necessarily delayed till next month.

Princeton University Observatory, May 16, 1900.

THE EMIGRATION TO CAPE NOME.

An attempt has been made by the transportation companies interested in Alaska, and particularly in Cape Nome travel, to approximate the probable emigration to the latter port for the coming season, and the conclusion is that the estimates of 30,000 or 50,000 persons made by sanguine observers will hardly be reached. There are, at this time, fifty-eight steamers of all classes charted for Cape Nome, to sail before June 1. The capacity of all these vessels is not beyond 15,000 travelers, and probably not more than 13,000 will take passage on the first trip.

As far as learned, every steamer has been sold up; but, as is always the case, many persons will defer the trip and await further advices before making the uncertain venture.

It is estimated that 5,000 tickets have been sold from San Francisco and 8,500 from ports of Oregon and Washington. If all of these are used, the full capacity of all vessels now chartered will be appropriated.

Estimating at 2,000 the number of people who wintered at Cape Nome, and the same number coming from other Alaskan points added to the 15,000 estimated to arrive from the States, would give 19,000 as the number likely to be found on the peninsula by July 1, 1900.

The early arrivals are likely to experience great hardship in landing. In 1899 the ice disappeared on June 21st. How those who arrive about the 1st of June are to land is a problem of infinite difficulty. The steamers will delay not a moment, and landing over the ice will be accompanied by great exposure and many uncertainties. The fatality is likely to be great.

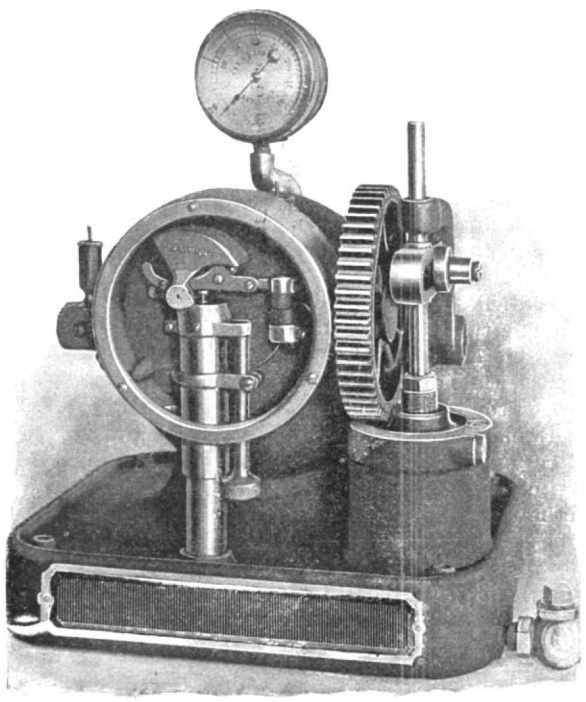
The subsequent voyages will be eminently easy. The crowd is out of the way and the difficulties of landing will all disappear.

SIR WILLIAM H. BAILEY, of Sale Hall (England), has presented a meteorological clock to the new Sale Park. This unique gift will indicate the time on a large dial, while at the same time the mechanism of the clock will actuate a drum, upon which there will be recorded the fluctuations of the barometer, the direction of the wind, the rainfall, and variations of temperature. The diagrams will constitute weekly records. The clock is a great improvement upon any existing time piece of its character. It is to be erected in the Joule Memorial Tower, which has been erected to commemorate the fact that Dr. Joule, who discovered the mechanical equivalent of heat, and who was also one of the greatest investigators of the age in physical science, resided for several years in Sale.

A SMALL AUTOMATIC ELECTRIC AIR-PUMP.

A very simple and effective electric air-pump for purposes requiring only small pressures, has recently been introduced by the Auto-Electric Air-Pump Company, of 38 Cortlandt Street, Manhattan, New York city, which pump is noteworthy for the ingenious mechanism employed in automatically breaking the circuit when the pressure becomes excessive.

Air is forced into a supply-tank by means of an air



ELECTRIC DRIVEN AIR-PUMP FOR LIGHT SERVICE.

compressing cylinder 3 inches in diameter with a stroke of 3 inches, the piston-rod being provided with a slot which receives a pin projecting from a gear wheel, driven by a pinion on the shaft of the motor. The piston is reciprocated as the gear-wheel is turned. The current used is derived from an ordinary 110-volt electric light circuit. The motor is of one-sixth horse-power and requires slightly less than one ampère.

The automatic regulation device consists of a small branch-pipe connected with the air-supply tank and provided with a spring-pressed piston or plunger, the rod of which is designed to operate a heavy tumbler. In its normal position the tumbler serves to depress a pivoted lever carrying at one end a carbon contact, which, when in engagement with a similar, lower, fixed, carbon contact, completes the circuit and causes the pump to force air into the tank. Should the pressure become excessive, the plunger is forced upward against the tension of its spring; the plunger-rod gradually lifts the tumbler so that it falls back on the other, upturned end of the lever, thereby raising the contact, breaking the circuit, and stopping the pump. When the pressure is reduced, the spring returns the plunger; the tumbler falls back to its original position, thereby depressing the contact-end of the lever, completing the circuit, and starting the pump. A set screw is provided, whereby the tension of the spring can be so regulated that the circuit can be broken when any desired pressure is attained. Once started, the pump operates automatically, without requiring any attention whatever.

The small size of the apparatus—it occupies barely a cubic foot of space—naturally adapts it to a great number of uses. Physicians have very successfully employed it in connection with atomizers. For airbrush artists and photo-engravers it is particularly serviceable; for it gives a continuous pressure without exertion, leaving the hands and feet free. The operation of dentists' instruments, the pumping of ale or beer, the driving of clocks, the inflation of bicycle and automobile tires, and the provision of power for every kind of small motor, are purposes which it admirably serves. The cost of operation is small; for the current used is about equal to that required by a sixteen candle-power incandescent lamp.

THE reclaiming of unhealthy districts in Palestine is being attempted by the planting of immense eucalyptus groves; in one place there are three-quarters of a million trees.

SHOULDERING CAR FOR LEVELING AND TRIMMING ROADBED.

A large part of the labor of the section gangs which keep in order the 200,000 miles of track in this country is devoted to the work of leveling and trimming the roadbed and preserving the proper width, level and slope called for by the standard cross section of the road. Ordinarily this work is done by hand labor, and it requires a considerable amount of work and an accurate eye to preserve that evenness of cross section and level which are necessary if the track is to have a thoroughly finished and first-class appearance.

By the courtesy of Mr. Frank Barr, the assistant general manager of the Boston and Maine Railroad, we are enabled to illustrate a machine which is designed for performing mechanically and cheaply the work which hitherto has been done by hand.

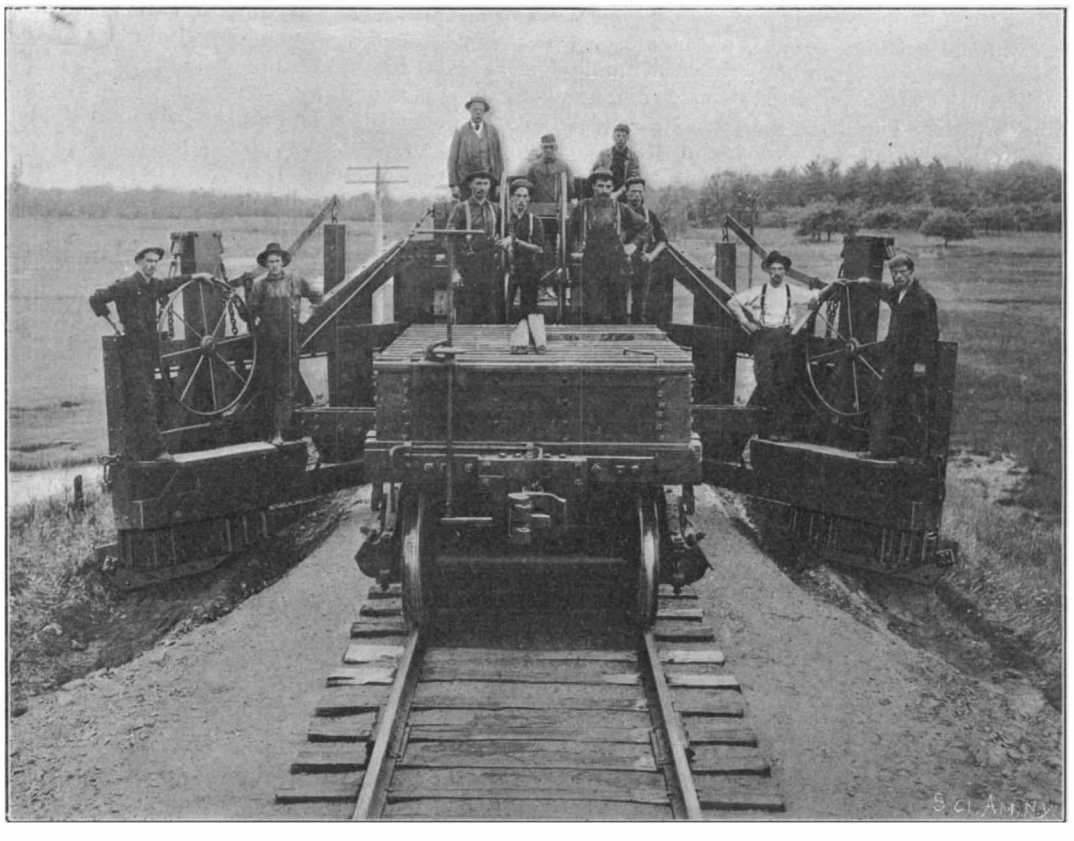
It is known as a roadbed shouldering and leveling car. It was built at the Concord shops of the Boston and Maine Railroad, early last season, and has now been in very successful operation for over twelve months on the various lines of the company.

The machine consists of a specially constructed flat car, of 70,000 pounds capacity, to the framing of which there are attached, one on either side, two massive extensible wings, which may be folded back against the sides of the car, or thrown out to give a maximum reach of 12 feet beyond the outside of the rail. The wings, which are of very strong timber construction, carry a vertically adjustable cutter, with a steel knife attached at its lower edge. In one type of car, the cutter is raised and lowered by means of a 10-inch air cylinder, which is bolted to the framing of the wings; but in the car shown in our illustration, the same duty is performed by means of a rack and pinion, the rack being secured to the cutter and the shaft which carries the pinion being carried on the wing. In the former case, one man is sufficient to raise and lower both wings, while with the rack and pinion, two men are necessary for each wing.

The operation of the car is very simple and is well illustrated in our engraving. The cutters are lowered to the proper level, with their cutting edges adjusted to the desired pitch of the embankment, and, as the machine is drawn forward by the locomotive, it forms a perfectly regular and even slope or shoulder on each side of the roadbed. The car is used for a variety of purposes, among which may be mentioned the following:

Leveling the sub-grade for a parallel track; widening out a fill, or grading for additional tracks, in which work, by extending the wings, gravel or other material can be leveled off to a width of 12 feet or more from the track, and to any desired depth not exceeding 18 inches. The car is also used for weeding and cutting ditches on either side of the roadbed. In doing its special work of shouldering, it is particularly effective, judged from the standpoint of appearance, as it leaves the shoulder with lines exactly parallel to the rail, whether it is working on a straight or on a curved track. As a result, not only is a uniform cross section obtained but the drainage of the track is greatly improved, and a large amount of "shimming" is avoided during the winter months.

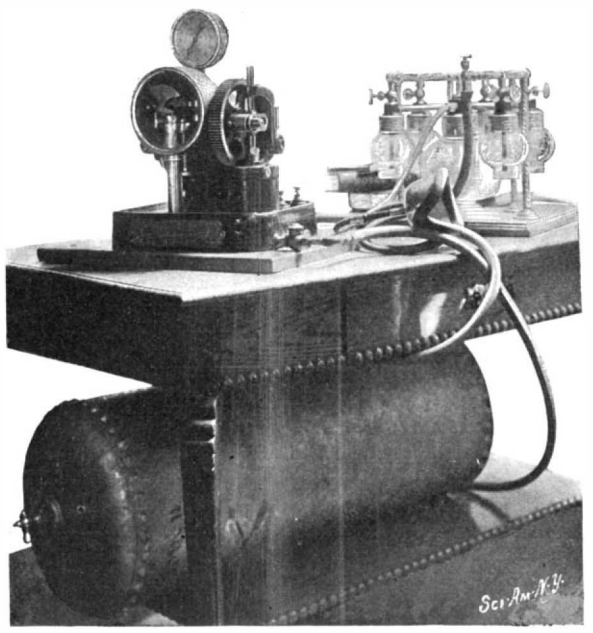
As compared with hand labor, the machine has proved to be extremely economical, and the saving in cost of labor being estimated at 85 per cent. As an instance it may be mentioned that a 30-mile section of the Boston and Maine Railroad was trimmed with the car in four days; whereas the same work, if done in the same time, would have required the employment of 375 men. As it was, the working force required, in addition to the locomotive, consisted of a train crew, a foreman, and four men.



SHOULDERING CAR FOR TRIMMING ROADBED.

Alcohol Obtained from Wood Electrolytically.

A new process has been devised in France by Magnier and Brangier for obtaining alcohol from wood by an electrolytic method. It is not, however, the methylic or wood alcohol which is obtained, but ethyl alcohol. The idea of the process is to transfer the cellulose of the wood into dextrine, glucose, and finally to



PUMP ARRANGED FOR PHYSICIANS' USE.

alcohol; this is accomplished by electrolyzing under pressure the wood fiber, this having previously undergone a suitable treatment. The wood is reduced to small fragments and is digested for two hours at the boiling point in a vat containing milk of lime, to which a certain proportion of chloride of lime is added; toward the end of the operation sulphuric acid is added in sufficient quantity to give a slightly acid reaction. The matter is transferred to another tank and heated to the boiling point with sulphuric and phosphoric acids in the proportion of two per cent; after several minutes, when the attack is considered sufficient, the mixture is introduced into a closed vessel and treated at a temperature of 150° to 160° C. The transformation of the cellulose into drextrine and finally to glucose takes place with great or less rapidity according to the temperature of the operation. The matter is then submitted to the action of an electric current, which renders the saccharine matters susceptible of fermentation under the action of appropriate ferments; it is then placed in fermenting vats, and a certain proportion of albuminoid substances added, and after the process is completed, the resulting alcohol is obtained by distillation. This method of operation is said to give very successful results, and different fibers, such as straw or vegetable stalks may be thus treated.

The Dunes of Gascony.

The dunes of Gascony are most remarkable. They rise, in one case, as high as 290 feet and very frequently rise to 130 feet over a belt of several miles wide and 150 miles long. Near the sea the ridges lie north and south, parallel with the shore. Further inland they trend east and west, parallel to the prevailing winds. Fields and forests were buried and the villages were overwhelmed by the advancing sand; mouths of streams were blocked and lagoons were pushed inland, invading and drowning fields and villages. Now, says Science, after many years of experimental effort and nearly a century of systematic work, the advancing dunes have been arrested. A half artificial dune or dike runs along the beach with a very gentle slope to the sea. Here the wear of the winter storms must be repaired during the succeeding summer. Next follows a protection zone, 1,000 to 5,000 feet wide, covered with stunted firs and bushes where the first strength of the sea wind is expected. Then comes the great artificial forest of firs and oaks, under whose cover the invasion of the dune has entirely ceased.

COUNT VON ZEPPELIN'S AIRSHIP.

Moored in the Lake of Constance, near Manzell, is a huge house, 472 feet long, in which an airship is now nearing completion, which is the embodiment of the most daring and ambitious plan ever conceived to solve the problem of aerial navigation. Within this floating workshop Count von Zeppelin has for months superintended the construction of his dirigible airship, by far the largest which has ever been built.

Von Zeppelin's ship consists of a colossal aluminium frame, 416 feet in length, 38 feet in diameter, which, in cross-section, is a twenty-four sided polygon. The cross-sectional area of the balloon-body is only 1114·72 square feet, and the entire air-resisting surface, projected upon a vertical plane, has an area of 1188·87 square feet.

The frame is composed of aluminium trellis work, covered with a fabric of which the upper surface is composed of pegamoid, and the under surface of silk. A netting of ramie fiber, which covers all the metal contruction, protects this double envelop from injury by the wire framework. The body of the balloon is divided into seventeen compartments, each of which is designed to contain a gas-bag. Of these compartments, fifteen are 26 feet long, and the remaining two 13 feet long. The gas-bags are likewise protected from injury by ramie netting. Above and below the front portion of the balloon body and at each side of the rear portion, rudders are located. The two four-bladed screw-propellers are mounted at each side of the balloon-body, at a height approximately equal to that of the center of air resistance. Each propeller has a diameter of 3·77 feet, and a speed of 1,100 revolutions per minute.

The merit of this compartment construction is evident enough. Although it increases the weight considerably, it tends to preserve longitudinal stability; for the shifting of the gas caused by oscillation of the longitudinal axis is confined to very small spaces and is, therefore, rendered almost inappreciable.

Six and one-half feet below the balloon body, and rigidly connected therewith, is an aluminium platform or bridge, 301·76 feet long, connecting two aluminium cars, each containing a 16 horse power motor and a 23·778 gallon tank, holding sufficient benzine for a run of ten hours. Beneath the airship a rope is suspended (omitted in Fig. 2) upon which a sliding weight (220 pounds) is carried, which can be adjusted to keep the ship in proper longitudinal trim.

Comparing the ever-memorable airship of Renard and Krebs, which had a maximum cross sectional area of 595·225 square feet, with von Zeppelin's balloon, we find that the cross sectional area of the latter is 1·95 times greater. The experiments of Renard-Krebs and of Tissandier proved that the actual velocities attained by airships were proportional to the cubic roots of their motive powers, acting upon the same cross sectional area. For a cross-sectional area of 100 square meters, 29 H. P. of the total 32 will be available for von Zeppelin's balloon; in the airship of Renard and Krebs, 14·87 H. P. were necessary for a speed of 6·5 meters per second. Hence the actual speed of Von Zeppelin's airship will be:

$$v = 6{\cdot}5\sqrt[3]{\frac{29}{14{\cdot}87}} = 8{\cdot}12 \text{ m. (30·6336 ft.) per second.}$$

In this calculation we have not considered factors in favor of Zeppelin's airship, such, for example, as the form and rigidity of the resisting surfaces, the lateral arrangement of the screws at about the height of the central point of resistance.

The question naturally arises: How great must be the power to drive a vessel with the 110·449 square meters (1188·87 square feet) maximum cross sectional area of von Zeppelin's airship? The most trustworthy formula applicable to the problem is that of Ritter von Loessl, which reads:

$$R = \frac{8}{g} F v^2 \sin \alpha.$$

In this equation R = resistance of the air to an inclined surface; g = acceleration of gravity (980·94 centimeters per second); F = the area of the surface in square meters; v = the relative velocity in meters per second of the resisting surface in air; α = the inclination of the surface to the horizontal. Roughly substituting von Zeppelin's quantities in Von Loessl's formula, we obtain: $R = \frac{1}{10} . 110 . 8^2 \sin 30° = 352$ kilogrammes wind pressure. Hence we obtain for the energy necessary to drive the ship at an approximate speed of 8 meters per second, $352 \times 8 = 2816$ kilogramme-meters = 20368·73 foot pounds, which divided by 550 gives approximately 37 horse power.

In this computation the favorable form of the nose has not been considered. Since in the Renard-Krebs airship the calculated horse power was found to be considerably in excess of that actually required, von Zeppelin is justified in assuming that 32 horse power is amply sufficient for the purpose of propulsion.

The weight of both motors is 1,430 pounds; the hourly consumption of fuel, about 26·4 pounds. Since the ballast of the airship will consist entirely of water, the cooling-water need not be added to the weight of the motors. The total weight of Von Zeppelin's motors is therefore reduced to 45·54 pounds per horse power hour. The driving shaft, as shown in Fig. 5, is geared to two diagonal shafts which drive the propellers.

The balloon body of von Zeppelin's airship will contain 11,300 cubic meters (399059·5 cubic feet) of gas and will consequently have a lifting capacity of 10 tons. From calculations which have been made, the total weight, including the crew of five men, will probably be 10,000 kilogrammes (9 tons), leaving 1 ton as a remainder. The actual figures can be given only after the ship has been tried.

The motors, as shown in Fig. 3, were subjected to very severe tests on a boat 36 feet in length, 6½ feet in beam. With the rearmost screw alone running at 1,100 revolutions, the boat was driven along at the rate of 6·8 miles per hour. With all three screws running, a speed of 9·3 miles was obtained. Each motor used 13·2 pounds of benzine per hour. And since each benzine tank will have a capacity of 132 pounds, the ship can sail for ten hours. At the previously mentioned speed of 8·12 meters per second, 288 kilometers or 179 miles will be the normal radius of the ship. But since the lifting-capacity is such that 800 to 1,000 additional pounds of benzine can be carried, the ship can readily journey from thirty to forty hours, so that its radius will be considerably increased.

The airship is a balloon, with all the faults and all the merits of a balloon; but it is also a flying machine. The greatest difficulty in its navigation will be the preservation of its stability in the air, a task which requires a constant allowance for the losses in gas, shifting of the load, and effect of wind pressure. These are matters which are of the most vital importance to the aerial navi-

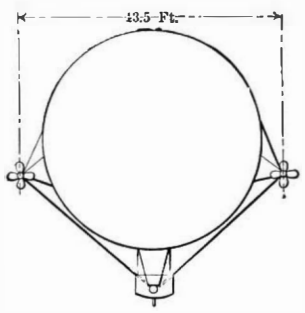


Fig. 1.—END VIEW.

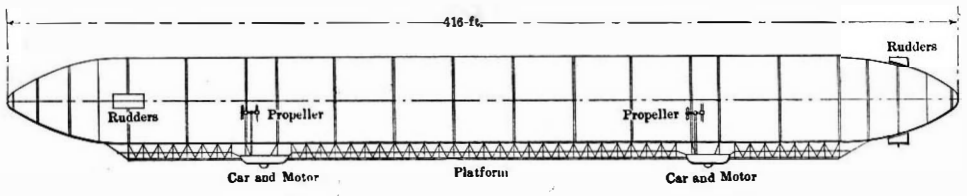


Fig. 2.—SIDE ELEVATION OF THE AIRSHIP.

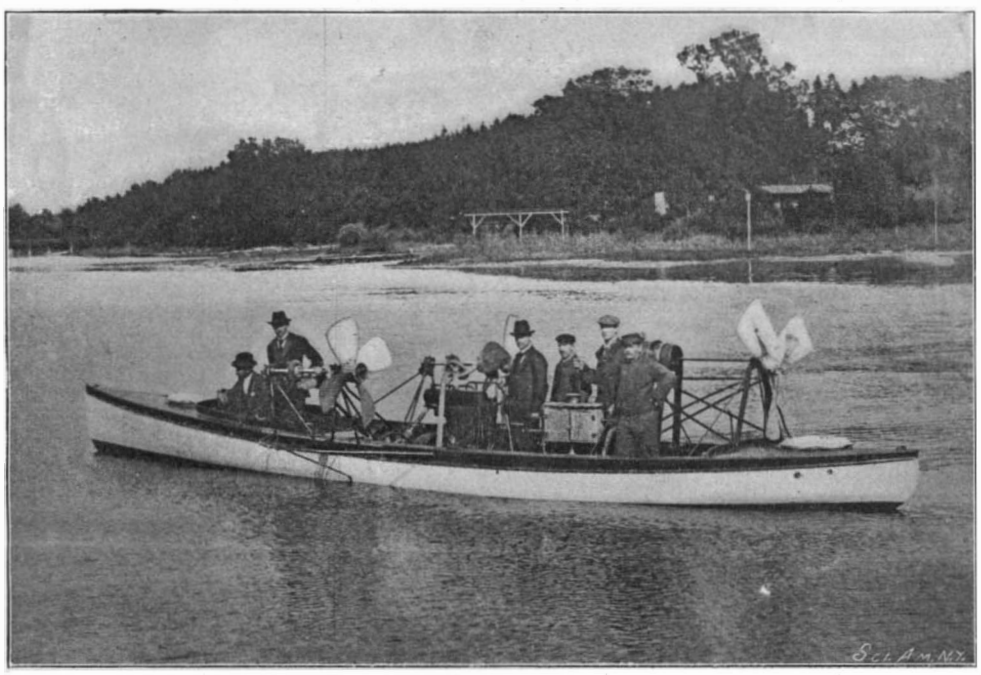


Fig. 3.—TESTING THE MOTORS OF VON ZEPPELIN'S AIRSHIP.

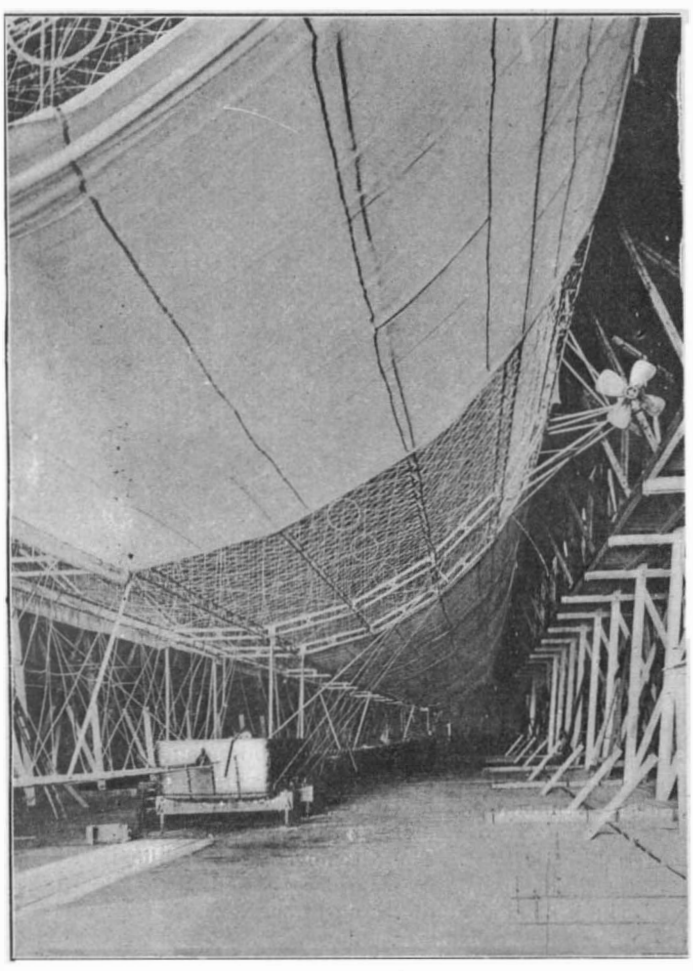


Fig. 4.—PARTIALLY ENVELOPED FRAMEWORK.

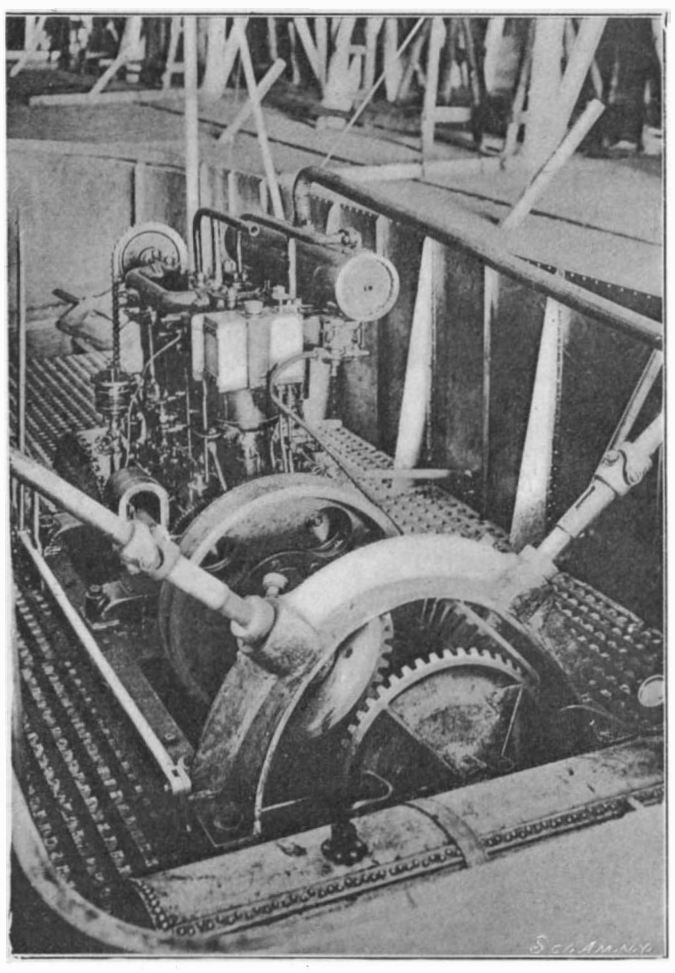


Fig. 5.—INTERIOR OF A CAR, SHOWING THE 16 HORSE POWER BENZINE MOTOR.

gator. The man who will guide von Zeppelin's airship will in a measure be the plaything of natural forces which at present lie without the province of human experience. He must be cautious; for he must learn by actual practice what he does not already know.

It is evident that the loss in gas for seventeen balloons will vary. So long as this loss is equal in both halves of the airship, or so long as this loss is compensated for by throwing out ballast or shifting the sliding weight, stability will be preserved. But it is clearly necessary that in each car a man should be posted whose duty it should be to maintain the stability of the vessel by jealously watching the gas-bags. The judicious use of a horizontal rudder would correct the errors due to the inability of the two men to work in unison.

BORAX—OLD AND NEW METHODS OF PRODUCTION.

In the United States the annual consumption of borax is about 12,000 tons. Prior to 1864, consumers were dependent upon Europe for their supplies. In that year the deposits in California, which were discovered in 1856, yielded 24,304 pounds, which sold at 39 cents a pound. With the increased production prices declined somewhat, so that in 1872, the year the Nevada deposits were discovered, prices had fallen to 32 cents. The production for that year was 280,000 pounds. In 1873 supplies from Nevada and from the new San Bernardino County deposits, recently discovered, brought production up to 2,000,000 pounds, causing prices to decline to 24⅛ cents. The succeeding year the production was doubled, with prices declining to 14⅛ cents. From that year to the present, production has steadily increased, with some interruptions, until the maximum of 1899 has been reached with prices 7 cents a pound. The lowest price ever known was in 1887, when borax sold at 5¾ cents. The Dingley tariff not only cut off foreign importation, but raised the price of the native product from one to one-half cents a pound.

The high price prevailing in 1872 stimulated the search for new deposits, and, in that year, Teels borax marsh near Columbus, Nevada, together with Rhodes, Columbus, and Fish Lakes, all in the immediate neighborhood, were located and promptly developed. The supply was largely increased from these fields. In 1880 the largest deposits of all were discovered in the lowest depression of Death Valley. The Amargosa borax deposits, with the Monte Blanco borate mine of this section, are of enormous extent and fully capable of supplying the world for an indefinite time. These mines are located in a region the most forbidding, remote from the railroad and offering almost unsurmountable difficulties in the reduction and marketing of their product, but their richness and extent, compared to all other fields, soon caused them to be regarded as the principal source of supply for the future production of borax in the United States.

The early production of borax was by dissolving crude borate of lime and applying heat. The liquor was drawn off and the borax allowed to crystallize. Fuel was procured from the pine forests of the neighboring mountains, and, to some extent, from the roots of the mesquite.

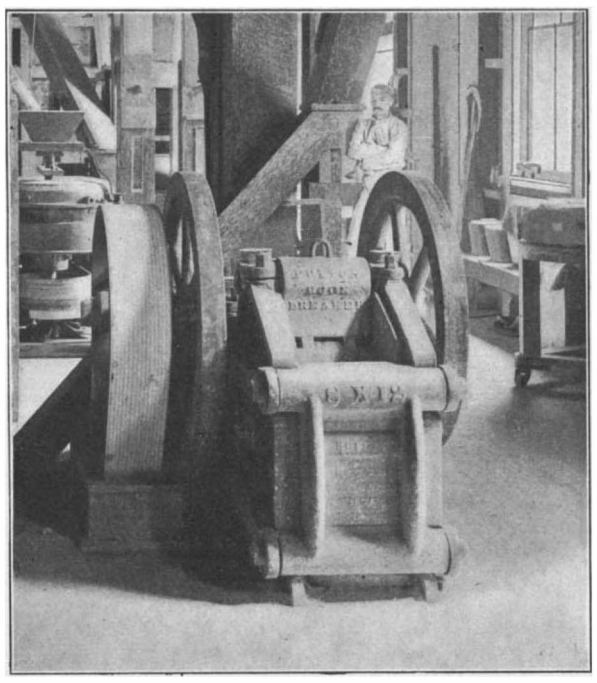
From the borax marshes in Death Valley to the nearest railroad point was 165 miles. Over this distance all supplies for the camp as well as the manufactured borax had to be hauled. The wagons used for this purpose were the largest vehicles ever made and carried 20,000 pounds, taking twenty-four horses to pull them. They traveled about 17 miles a day, and were compelled to carry a tender for water as well as feed for the stock. Springs of water were wide apart, and each journey was but a repetition of hardship and adventure. Many tragical tales are told of sanguinary fights between teamsters and tramps of the road, of men dying from heat or becoming insane from thirst. This method of marketing the product was extremely expensive, and the constant decline in prices that accompanied increased production would have stifled the industry, had not the discovery of vast deposits of borate of lime in the Calico Mountains, and only about eleven miles from the railroad, opened up a new and permanent supply and in quantity sufficient for whatever demand might be made upon it.

Until the discovery of deposits of borate of lime in the Calico Mountains, borax had been a product of the marsh and of methods the simplest, admitting no improvement in mechanical appliances. An entirely new era opened with the discovery of borate of lime in stratified rock formation. Thenceforward the industry was transformed into a proposition akin to that of quartz mining and allowing an abandonment of the necessarily rough methods of the marsh system of production.

Mechanical ingenuity superseded the wasteful agencies of the past and allowed the introduction of economical methods of manufacture and an adaptation of scientific principles. For hand labor was substituted mechanical appliances realizing certain results and greater purity of the product.

Borate of lime as mined at Calico is found in strata as well as in chambers sometimes as large as a house. The shafts are driven 600 feet below the surface, where the deposit is extracted in the same way as quartz.

At Calico 2,000 tons a month are produced from the mines. Here it is loaded in cars, and by means of a branch railroad, eleven miles in length and owned by

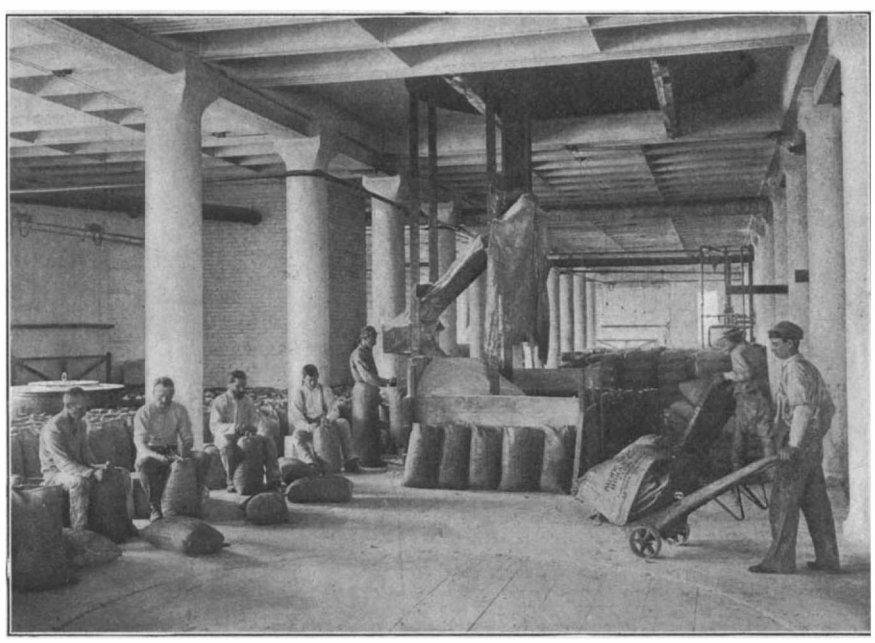


GRINDING CRUDE BORATE OF LIME.

the company, it is hauled to Daggett and thence finds its way to tidewater on San Francisco Bay.

The great wagons of the desert are things of the past, and the saving of expense of the 160 miles hauling has preserved an important industry from succumbing to the cheap labor of overcrowded Europe.

The works employ from 400 to 1,600 men. The crude borate of lime is first passed through rock breakers and is then ground to the fineness of flour by means of rolls and burr stones. It is then, with a small proportion of carbonate of soda, thrown into a digester, where under heat, pressure and agitation the existing affinities are completely divorced. The carbonic acid unites with the lime, which yields boracic acid, the latter with a small portion of soda and the result is borax in solution. The liquor is then drawn off into tanks, where the borax in crystallizing attaches itself to



PACKING BORAX FOR SHIPMENT.

small steel rods and hooks altogether like great sticks of rock candy. The sediment contained in the mixing tanks is composed largely of sand and dirt with considerable borax mixed. The deposit is passed through a filter press, which presses the dirt and allows the borax liquor to pass away to be utilized again. Repeated over and over again, the last remnant of borax is finally secured by this process.

The uses of borax are extending year by year. The meat purchasers of the country are the largest consumers, absorbing 6,000,000 pounds and over annually. For mechanical purposes the demand is constantly increasing, but it is in the domestic consumption of borax that the expectation and hope of the industry is centered. For a hundred different demands of household economy the advantages of borax as an adjunct of the kitchen, laundry, nursery, or toilet, as a sanitary agent of value and even as a medicinal quantity, has been found of such positive value as to insure a constant and increasing element in the world's necessities.

Seedless Oranges.

Twenty-five years ago there were no seedless, or navel oranges grown. A few oranges were raised in Florida, but the bulk of the supply came from the Mediterranean, and the fruit was expensive. The annual yield of California oranges was less than five carloads. Now the annual orange yield in California is upward of 15,000 carloads, and the total amount invested is now something like $43,000,000, while twenty-five years ago it was only $23,000. The introduction of the seedless, or navel orange has caused these changes. It has revolutionized the orange industry of the United States, drawing 13,000 men out of other pursuits and has transformed vast areas of sun-baked land in California into beautiful orange groves. The New York Sun recently had an interesting article on this subject, from which we derive our information.

The first seedless orange trees were introduced in 1872 through the efforts of William F. Judson, United States Consul of Bahia, Brazil, who heard from the natives of a few trees in the swamp on the north bank of the Amazon, some sixty miles inward, which had no seeds. It seems that even in those days there were Consuls who were interested in scientific matters, and could foresee the economic value of a discovery of this kind. He sent a native up the river to get some shoots, and bring back some of the fruit. Several of the shoots were packed in moss and clay and were shipped to the Agricultural Department at Washington. They did not excite very much attention at first, but the next year Mr. Horatio Tibbetts asked the Agricultural Department for specimens of fruit and shrubs suitable for experimental propagation in Southern California. Among other things Mr. Tibbetts obtained the four surviving orange tree shoots from Brazil. They were shipped to Riverside, California, and were immediately planted. Even here the shoots appeared to have had bad luck; one died of neglect and another was chewed up by a cow. Five years passed and the two surviving trees come into bearing, and in the winter of 1878–79 they bore sixteen oranges of the seedless variety—the first ever grown in North America. Specimens were shown to orangemen and fruit growers. At first they were sceptical as to whether the trees would bear annually such fine specimens. The second crop was awaited with great anxiety. There was about a box of oranges in the second year's crop and they were even better than those of the first crop. Mr. Tibbetts was sure that there was a fortune in the new variety of oranges. For two years he experimented with propagating trees from shoots and cutting from his two seedless trees. His attempts were a failure, but finally he hit upon a scheme of budding from the seedless navel trees upon the seedling trees. Experiments along that line were successful, and it was found that a bud taken from one of the two Tibbetts trees and grafted into the bark of a seedling tree would grow to be a limb which would grow seedless oranges. The original orange branches were then cut away and the tree thereafter bore only the new variety of fruit. Work was carried on in earnest in the winter of 1882 and in the following year the demand for buds was so large that a dozen frequently sold for $5 and $1 each was finally not considered excessive for a good bud. A fence was built around the two trees to protect them and a year or two latter the orange trees that had been propagated from the two original trees began to bear and they furnished tens of thousands of navel buds, which were as good as those from the two original trees. The industry has grown until now no one thinks of planting seedling oranges, and tens of thousands of seedling trees have been budded into navel orange trees, and there are many navel orange groves in the region which have yielded net profits of from $250 to $300 an acre a year. Riverside has grown from a hamlet of less than thirty American inhabitants to a prosperous town with 14,000 population. It is the greatest orange producing locality in the world, 16,000 acres of the land being devoted to it. The average annual shipments of the oranges from Riverside are 1,600,000. boxes. The Riverside citizens are now urging that the two trees which were the source of this prosperity, be removed to a public park and suitably protected in order that they be kept for the next generation as an object lesson. No visitor is allowed to take any flower or fruit into the orchard for fear of the scale.

In many post offices in England sealing wax is melted and kept in a liquid state by electric current.

Science Notes.

The bust of the late Prof. Egleston and a bronze tablet will be given to Columbia University by the students of the School of Applied Sciences.

A book industry exhibition will be held at Gothenburg from July 15 to September, 1, 1900. It is expected that the exhibition will be of great interest, not only to printers, but also to the public at large. Rare and unique books, prints, etc., which are of value especially to printers will be shown. The exhibition will be the first of its kind ever held in Sweden and contributions from foreign countries are expected. There will be a printing office in operation and if possible, it is intended to illustrate the progress of art by exhibiting a printer's shop of the middle ages and a paper factory producing hand-made paper.

The eclipse of the sun of May 28 will be visible in Europe about 4 o'clock P. M. in Spain and Algeria, but the time of the eclipse will be very short, only 2 minutes 14 seconds in the most favorable localities. It will be only partial at Paris and throughout the rest of France. The astronomers who are to observe the eclipse have taken all the necessary measures to obtain good results. The Astronomical Society of France has sent two expeditions to the regions of total eclipse; one of these will be installed near Alicante and the other in Algeria. Besides the American expedition under Messrs. Percival Lowell and Todd, several English expeditions will be installed in Spain and Algeria.

We have already discussed the excavations of the Roman Forum. Signor Giacomo Boni describes a most interesting scientific discovery. This is that the sacrarium of Mars was an actual and genuine sacred seismic observatory, the shocks of earthquakes being registered by the oscillations of spears. The spears kept in the Regia were venerated as the weapons of the mythical father of the first king and founder of Rome. The spears were wooden rods with metal points, and they were in themselves objects of worship. It is not known whether the spears were suspended so as to register the smallest oscillation, but it is certain that their vibration was considered as a forerunner of disaster. The oscillations of the spears were registered in classical writings as in Livy: "Hastæ Martis motæ," the date is 570 A.U.C. Similar instances occur for 635, 650, 654 and 657. In the small group of the Regia, the temple of Vesta, the sacred well in the intervening way were assembled, and not all of them by chance. All connected with those natural phenomena which most impressed primitive man, earthquake, fire and lightning. Professor Boni's most interesting paper is published in the current SUPPLEMENT.

The International Conference for the protection of wild animals in Africa recently began in London and was opened by delegates from many countries. Concerted action is necessary in order to obtain an international agreement to restrain the extermination of many of the mammals, birds and fishes in Africa. It is useless to preserve wild animals in one part of Africa, while they are killed off in neighboring districts by persons claiming to be citizens of other European States, so that an international agreement is sought for. It is needless to dwell upon the unnecessary slaughter of elephants, rhinoceroses, hippopotami, the larger kind of antelopes, etc., since the Cape Colony, the Boer States, and the Rhodesian territories have been opened up to colonization. The establishment of large reserves like Yellowstone Park in the United States is advocated, where wild animals can be allowed to lead their natural life. The experiment has been tried on a small scale with considerable success. In a narrow strip of forest country on the south coast, the Government of Cape Colony preserves some herds of elephants. Ten or twelve of these large reserves will keep alive, for a time at least, the striking types of animal life in which Africa is so extraordinarily fertile.

Switzerland has not many feathered songsters, but those that do exist are carefully protected, not only by law, but by the fostering character of the people, particularly the German-speaking people of Switzerland. In northern Italy bird killing is an epidemic and this spirit has spread over the Swiss-Italian canton of Ticino. As the seasons come and go the Swiss birds make their pilgrimages south and in going and returning cross the land of northern Italy, and the Swiss canton of Ticino, and they are mercilessly pursued by hunters of all ages and all classes. On the Lake of Maggiore it is estimated that at least 60,000 feathered songsters are trapped and killed every year, and in the regions around Bergamo and Brescia many millions are slaughtered to satisfy the demands of tables and of the millinery establishments of the world. One of the schemes is to cover the limbs of trees with bird lime so that they become helpless captives if they stop in their flight for rest or for food; hundreds are often captured by this simple means. During the past year the border police of Ticino captured and destroyed 13,000 bird traps set to imprison the weary little flyers. Now, however, excellent laws are being enforced and the song birds of Switzerland may yet survive the attempt to exterminate them.

Engineering Notes.

Acetylene gas seems destined to play an important rôle in the illuminating world in Spain. Large numbers of generators are already in use.

Venice has been selected as the spot for a modern shipbuilding plant. The works will be erected on the island of Sant 'Elena at the eastern end of the city.

A railway is to be constructed from Damascus to Mecca in order that pilgrims may be saved from a sea voyage. It is proposed that the line shall be built by soldiers.

Irrigation is of the utmost importance in Persia, as cultivation depends upon it, and water is extremely dear. It has been suggested that artesian well manufacturers might find an excellent opening once that the success of these wells was assured.

It is suggested that it will be profitable to try the experiment of using gas engines for driving ships, the gas being generated on the vessel itself. Coal will be roasted in retorts aboard the ship in order to drive off the gas for the engines. The coke thus produced, says The Electrical World would furnish the fuel needed to roast the coal. The purpose of the experiment which is to take place is to ascertain whether the saving of weight of the gas-producing plant and gas-consuming engines over the ordinary plant of steam boilers and engines, and the saving of space are sufficient to warrant the adoption of a new system.

According to an English Consular Report, oil engines are rapidly advancing in favor in Palestine, for the purposes of drawing water from the deep wells to irrigate the orange gardens. Hitherto the water was pumped by animal power. There was a large water wheel, and from four to eight mules were required to revolve it, according to the size of the wheel. Not only was this a very slow and laborious method, but it was very expensive costing about two dollars a day. It has been found that with an oil engine of six horse power it is possible to pump double the quantity of water that was previously raised by eight mules while the average expense is about the same, since the engines consume about nine gallons of oil a day. Under these circumstances it has been found far more economical to use an oil engine upon the large plantations than to employ animal power.

The arrival last week at the port of New York of the twin-screw steamship "Grosser Kurfurst," after her maiden trip across the Atlantic, is the latest evidence of the remarkable activity which is being shown by the North-German Lloyd Steamship Company. This vessel is a representative of that rapidly increasing class of transatlantic steamers which combines large freight-carrying capacity with an extensive accommodation for passengers. The rapid growth in the size of modern steamships is shown by the fact that had this vessel come to New York some half dozen years earlier than she did, she would have been the largest steamship afloat. She is 560 feet long and 63 feet in beam, with a gross measurement of 13,000 tons and a displacement of 20,000 tons. Before being placed on the Atlantic route she was given an extensive trial by being sent on the round trip to Australia.

The Chemiker Zeitung examines the question of preserving the hulls of vessels from corrosion. The essential conditions of the preservative coat to be applied are that it should protect against all corrosion, the surface should be smooth, to avoid friction, and it should dry rapidly, so as to allow two coats per day. In the case of new steel cruisers, the black scale must be taken off by acid before applying the paint, as otherwise this will fall off with the scale and leave the metal bare. The best process is that of Rahtjen, using a solution of shellac in alcohol, with which is incorporated a little oxide of iron and a small quantity of linseed oil to give elasticity. The first coat serves to protect the metal, and a second is given of the same composition, to which arsenic and mercury are added. This is designed to prevent the adhesion of marine vegetation, owing to the formation of chloride of mercury under the action of the sea-water upon the mercury. This paint dries rapidly and several coats may be applied per day. The disadvantage consists in the fact that only a small quantity of mercury can be incorporated without attacking the shellac, and that the latter is slightly soluble, so that the preservative value is diminished in the course of time. The author points out the conditions under which the preservative action is exercised, and shows that the toxic substance added to the paint has the effect of killing the germs of crustacea which float freely during the first period of their development in search of a place to fix themselves, such as the side of a vessel. When the ship is displaced through the water the layer of paint is constantly affected by the friction, and the sea-water exercises a chemical action, causing the formation of antiseptic compounds at the surface of the hull, and thus destroying the organisms which come into contact with them. As long as the ship is in movement the successive layers of paint continue the action, and this only ceases when the toxic substance has been entirely used; the paint still continues to preserve the hull against corrosion.

Paris Exposition Notes.

In the Electrical Palace, the collection of historic apparatus shown by the United States will be of considerable importance. It will be contained in a pavilion which has been erected on the second floor, covering large space. The pavillion takes the form of a series of colonnades of white staff, enclosing the different spaces for exhibition rooms; as it extends nearly across the building, two passage-ways have been provided, besides which a central passage gives access to the central room, from which branch four side spaces. The colonnade is in the classic style and gives a pleasing effect. Over each of the doors is represented an eagle upon a shield, and along the upper part are a series of figures in white staff, upholding incandescent lamps. The pavillion is well provided with flags, and a large American flag hangs over the whole in a conspicuous place. The historic collection will include early apparatus used by the principal American scientists and inventors.

A novel form of electric fountain is to be seen in the attraction known as "Spain in the time of the Moors," its peculiarity consisting in the fact that no water is used. It was at first proposed to erect a fountain in the center of one of the large halls, having a jet about 6 or 7 meters high, but when the consumption of water was estimated it was found that the cost would be too great. M. Trouvé, the engineer in charge, found an ingenious solution of the difficulty. Below the large basin, whose sides are inclined toward the center, is installed a powerful electric ventilator, and above is the tube for the jet. An arc lamp sends reflected rays through the tube in the usual way, and instead of water, a certain quantity of rice grains mixed with mica and metal foil are used; this is blown up by the ventilator and falls from the tube into the basin, from whence it is taken again by the current of air. A disk of colored glasses turns below the tube and varies the light upon the jet.

One of the most novel, and interesting, exhibits at the Paris Exposition is a complete set of bed hangings manufactured in Madagascar from the silk of the halabe. The halabe is a huge, indigenous, female spider of great ferocity. It eats the males which venture near it, and will even devour the weaker members of its own sex. M. Nogue, the head of the Antananarivo Technical School has been studying the instincts and life of this insect for many years and after much perseverance has now perfected a neat arrangement for winding off the thread with which the spider spins its web. Each spider yields from three to four hundred yards of this silk which is somewhat finer than that spun by the silkworm, but, nevertheless, it possesses extraordinary strength and is of a light golden color. There is no doubt but that by M. Nogue's process the product of the halabe, like that of the silkworm, can be widely utilized for commercial purposes. The bed hangings exhibited this year at Paris are the first results of M. Nogue's invention and cannot fail to excite unusual interest.

At the Vincennes Annex have been erected several large buildings and pavillions to accommodate the various exhibits. The Transportation building will contain a number of locomotives, cars, trucks and automobiles. A Forestry building has also been erected, with a large pavillion. The United States has a large machinery building, in which will be installed various types of machines and dynamos; it contains a Shaw electric traveling crane, and to operate this, as well as to obtain the necessary lighting current during the construction, it was intended to erect an American engine and dynamo, but as these were sent over on the "Pauillac" nothing has as yet been heard from them; to supply the deficiency an English dynamo and engine were brought over and rapidly set up. In front of the building is a race track for bicycles, and in the interior will be a second track for foot races. Tiers of stone seats have been built along each side of the track. Around the lake a wide track has been constructed for automobile races. An aerostatic park has been laid out and a number of balloon ascensions will be made.

The representation of a naval combat in miniature with all the details is to be seen in Paris. This attraction is situated just outside the fortifications, where a large basin has been constructed, containing 10,000 cubic meters of water, around which have been arranged suitable decorations representing the port of a large city. The miniature boats attempt to reach the city, but are repulsed by the fleet situated in the port, giving rise to a naval combat in which the cuirassiers and torpedo boats go through their evolutions, with bombardment of the city or ports. The spectacle is viewed from a stand 80 meters long extending along one side. The small boats are an exact representation of the latest types of battleships; they are from 4 to 5 meters long, and are directed by a battery of accumulators and electric motors. Each boat contains one or more persons concealed in the interior, who direct the boat and carry out the necessary maneuvers; to represent the discharge of the guns, blank cartridges are fired from a small gun or pistol. The signals or lights are represented by incandescent lamps distributed around the boat.

THE SAULT POWER CANAL.

BY WALDON FAWCETT.

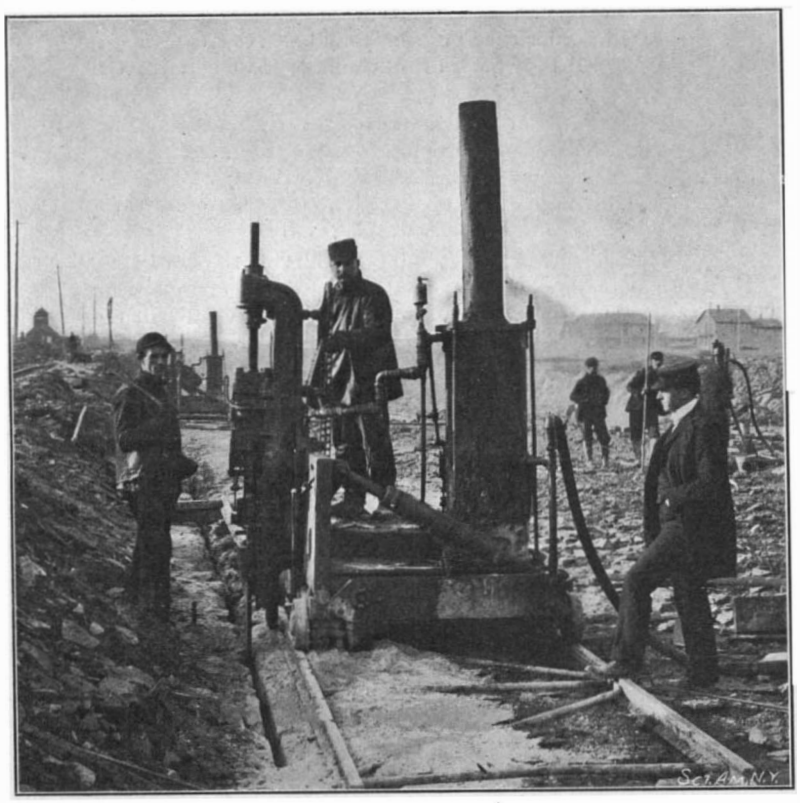
In this era of universal utilization of water power it must be no mean undertaking that is accounted the greatest hydraulic development ever attempted in the United States, and yet this superlative designation is precisely applicable to the great project which has been undertaken by the Consolidated Lake Superior Company in the construction of a power canal at Sault Ste. Marie, Mich.

The sister cities of Sault Ste. Marie, Mich., and Sault Ste. Marie, Ontario, are situated, it may be explained, on either side of the St. Mary's River, which connects Lakes Huron and Superior and through which passes the bulk of the enormous commerce of the great lakes. The river at a point opposite the cities takes a tremendous drop by means of rapids, and it was to obviate this obstacle to navigation that the United States and Canadian governments expended millions of dollars in the construction of a number of canal locks, one of which is the largest in the world.

About the time of the construction of the government locks the city on the American side experienced a distinct boom, but it died out, after the fashion of booms, more than a decade ago. Now there appears to be opening for the little city of ten thousand people a wonderful future as a manufacturing center. All the claims which have been made for the possibilities of development at Niagara Falls apply with equal if not greater force to Sault Ste. Marie. A water power canal half a mile in length is already in operation on the Canadian side, and a canal with a length of a mile and a quarter is under construction on the American side. The canal on the American side alone will supply a row of mills upon its banks more than a mile in length and will give each a fall of water of 18 feet and an ample quantity. In short, the whole scheme is designed, as it has been aptly expressed, to turn the twin cities into one vast water mill, with Lake Superior as a mill pond.

The summary given, too, is but an elementary outline of the project, for there is in contemplation a plan whereby the generation of electricity will enable factories of various kinds to secure power over an area fully fifteen miles in diameter. Senator McMillan, of Michigan, recently stated that he saw no reason why the water power should not be applicable to the mines and saw mills scattered so thickly throughout the adjoining territory, and a clew to the ultimate purposes of the master movers in this novel project may be gained from the fact that the same capital that is constructing the power canal is building a railroad from Sault Ste. Marie to Hudson's Bay, tapping unlimited storehouses of iron, nickle and copper.

The syndicate of American capitalists which is responsible for the hydraulic improvements at Sault Ste. Marie first acquired a right of way on the Canadian side of the river. The Lake Superior Power Canal Company was then formed and built a water power canal which developed 20,000 horse power. From the Lake Superior Power Company as a parent organization there was formed on the Canadian side the Sault Ste. Marie Pulp and Paper Company, which operates the largest pulp mills in the world, and other manufacturing corporations. On the American side the sub-organization took the name of the Michigan Lake Superior Power Company, and upon it devolved the development of the water power on that side of the river. Within the past year the Consolidated Lake Superior Company, with a capital stock of $20,000,000, was formed to absorb the interest of all the original companies engaged in the development of the industries of the two new industrial centers. An incidental organization also recently perfected was the incorporation of the American Alkali Company, which will use a considerable proportion of the power provided by the American canal. The last mentioned company, which will manufacture chemical products by electrolytic methods, has an authorized capital of $30,000,000.

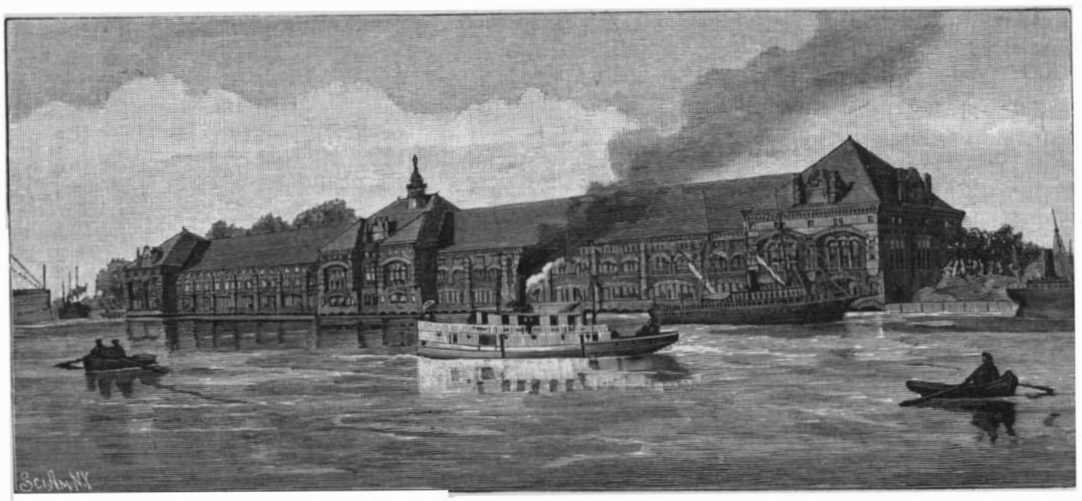


CHANNELING-MACHINES AT WORK IN ROCK CUT.

Measured according to the ordinary rules of hydraulics, the actual physical energy to be developed by the canal now under construction on the American side will amount to fully 60,000 horse power. The power house within which this power will be transformed into electrical energy will be nearly 1,400 feet in length, 100 feet in width and will rise 75 feet above the water level. The building contains eighty-one turbine chambers, each being about 16½ feet in width and containing four American turbines, installed in tandem fashion, and all connected to one shaft, at the end of which, outside of the turbine chambers, an electric generator is coupled. One of the turbine chambers, located in the central part of the building, will not be equipped with turbines, but will be utilized instead as a spillway through which accumulations of ice or debris may be discharged into the river without the possibility of the turbines sustaining any injury.

To facilitate description, the building may be divided into the component parts of foundation, substructure or pit, superstructure comprising pen-stocks and dynamo floor, mill floor and roof. The foundation consists of ten thousand 20-foot piles. The substructure consists of eighty-one pit walls each 100 feet long, 20 feet high and 3 feet thick, being closed at the up-stream end by arch-shaped forebay walls of the same height and thickness. A concrete floor is laid between each two walls in the shape of an inverted arch, and the top is also closed by a concrete arch. The pit and forebay walls are formed from concrete blocks fabricated in imitation of cut stones.

It will thus be understood that the substructure consists of 81 concrete tunnels, each 100 feet long, 15 feet wide, and 18 feet high, and open only at the downstream ends. Above these the superstructure is raised, consisting of 81 penstock partitions, each about 20 feet high, 40 feet long, and 17 inches thick. The downstream end between each two partitions is closed by a semi-circular steel plate bulkhead. By this arrangement the turbine chambers proper remain open, of course, on the up-stream side and top. Here the turbines will be installed, receiving the water from the front and top and discharging it through the steel penstock tubes into the pit below, whence the water escapes into the river. The installation of electric dynamos will occupy that portion of the pits not devoted to the penstocks. For this there will be provided a continuous floor about 40 feet wide and fully 1,400 feet in length. The mill floor will be of the same length by 75 feet in width.



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Length, 1,400 feet; width, 100 feet; number of turbine wheels, 320; number of dynamos, 80.

THE 60,000-HORSE-POWER POWER HOUSE.

Perhaps the best idea of the size of this great power house may be conveyed by the statement that there will be required for its construction a quarter of a million linear feet of piles; 100,000 linear feet of 12-inch logs, 40,000 cubic yards of concrete, 3,000 tons of structural steel, and 10,000 cubic yards of stone masonry. The installation will consist of 320 turbines and 80 electric dynamos. The estimated cost of the building is in the neighborhood of $500,000, and it is expected that the equipment will necessitate an additional expenditure of fully $750,000.

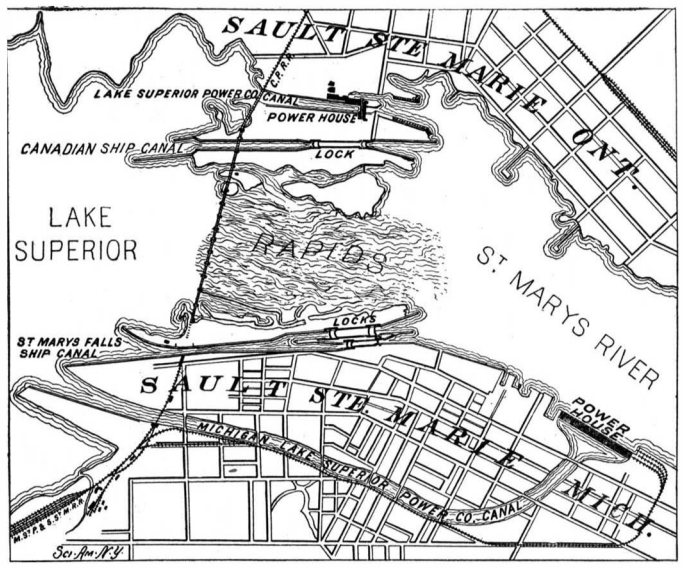
Lake Superior has an area of about 30,000 square miles and its mean outflow through the rapids at Sault Ste. Marie is about 90,000 cubic feet per second the year round. The mean elevation of the lake is 601 feet and the elevation of St. Mary's river below the rapids 582 feet, giving a vertical fall of 19 feet. The quantity of material to be moved in the construction of the canal on the American side, amounts to more than 500,000 cubic yards of rock and considerably over 2,000,000 cubic yards of other material.

Width on bottom, 200 feet; depth, 23 feet; length, 1¼ miles; available head, 18 feet.

EXCAVATION OF THE GREAT FEEDER CANAL OF THE MICHIGAN LAKE SUPERIOR POWER COMPANY.

The manufacturing interests to be developed at the Sault will undoubtedly be of a most extensive character. Mention has already been made of the pulp mills which give employment

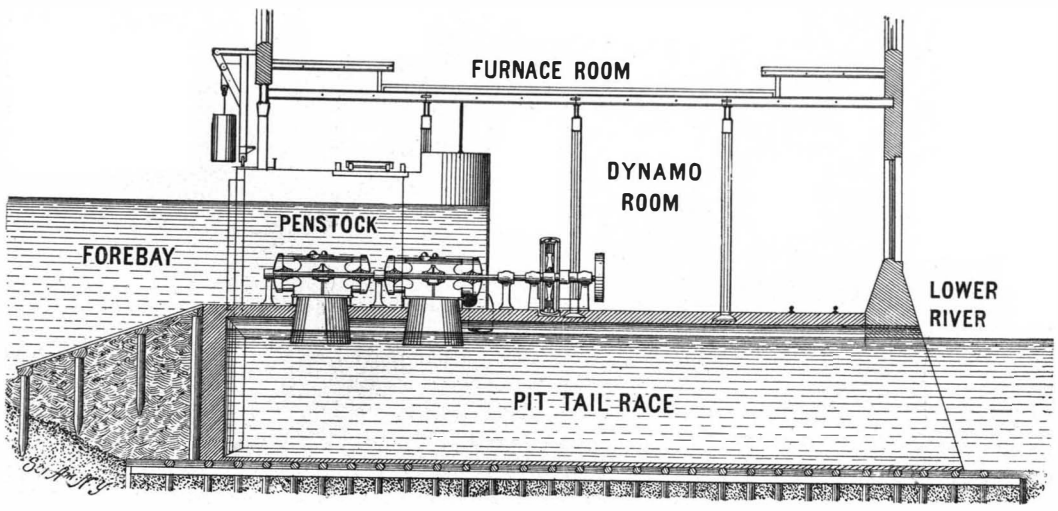
to a force of over 1,000 men. The Canadian Electro-Chemical Company on the Canadian side is the first in the Dominion to manufacture caustic soda and bleaching powder. The development of the nickle mines of New Ontario will be another ultimate result. These mines which are about 120 miles distant from the Sault are now capable of yielding 500 tons of ore per day, all of which will be utilized in the reduction works just constructed. These works will produce daily 250 tons of nickel steel, perfectly adapted to the requirements of armor plate manufacturers. It is claimed also that the process to be introduced at Sault Ste. Marie will so reduce the cost of production of nickel steel as to make it available for shafting and all other similar uses where severe strain is encountered. The company has already secured a contract to supply the Krupp plant in Germany. Then there is the general reduction works intended to reduce to the most perfect purity ores of all kinds and at so low a cost as to make of practical value many ores formerly considered useless. A calcium carbide works will be another feature.



MAP OF SAULT STE. MARIE, SHOWING RAPIDS AND LOCATION OF POWER PLANTS.

The project for the establishment of the power canal at the Sault was proceeded with so quietly that the work was well under way before the general public learned much if anything regarding the scheme. It is now expected that the canal on the American side will be in operation late in the present year, and those persons most thoroughly conversant believe that the Consolidated Lake Superior Company will not be much behind its rival at Niagara Falls in the development of 100,000 horse power.

During the early part of the present year the Lake Carriers' Association, comprising in its membership all the principal vessel owners on the great lakes, became aroused lest the power canal project would affect the level of Lake Superior and the ship canal and thus work serious injury to navigation interests on the inland seas. Representatives of the vesselmen's association declared before a committee of the House of Representatives that if the power canal lowered the level of the government ship canal around the rapids at the Sault so much as one inch, it would entail a loss of a million and a quarter dollars to the vessel and iron ore interests every year. Engineering experts have disagreed regarding the influence which the power canal will exert. Just what action will be taken is problematical, but that some legislative limitations will be exacted ultimately seems highly probable. Meanwhile, the excavation of the canal goes actively forward, and upward of fifteen hundred men are engaged in the work.



TRANSVERSE SECTION THROUGH POWER HOUSE, SHOWING FOREBAY, TURBINES AND TAIL RACE.

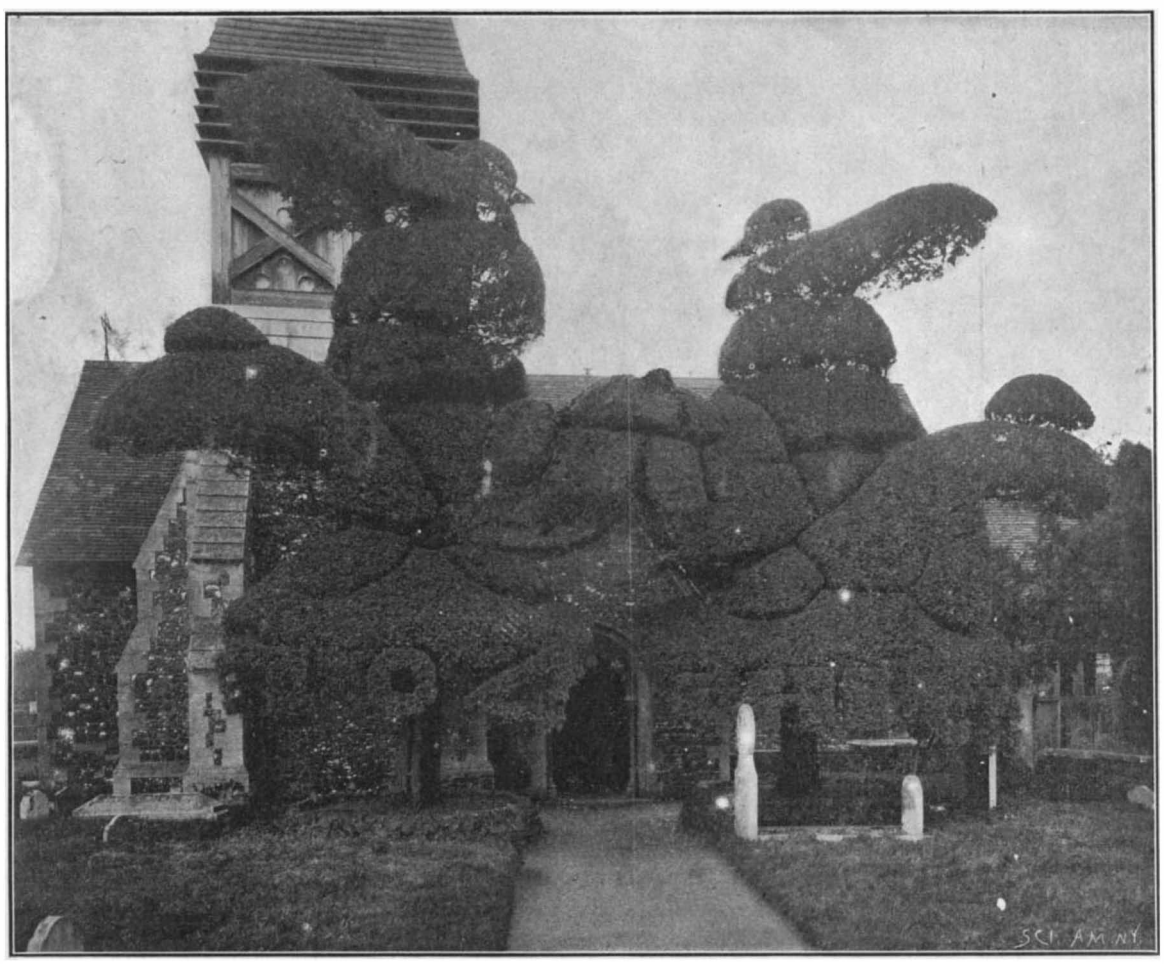
CURIOUSLY CUT YEW TREES.

The yew tree is often called the "melancholy yew," a description which is not altogether unwarranted, having regard to the position it usually occupies. The use of the yew tree in Christmas decorations in England is no new fashion, and several centuries ago the yew was more largely employed in decorations at Easter than at Christmas.

The common yew tree has a wide geographical range.

It is distributed over Great Britain and the Continent of Europe, its range extending from Norway and Sweden to the shores of the Mediterranean. It is also well represented in America and Asia. The remarkable longevity of the yew, coupled with its power to resist adverse influences, has given rise to the opinion that there is hardly any limit to the period of its existence, and the age of the majority of the more famous trees is greatly overestimated; many of the more noteworthy trees are undoubtedly several centuries old. The famous tree at Buckland, Kent, about a mile from Dover, was mentioned in the Doomsday Book, and is, therefore, of an age exceeding a thousand years. In 1880 it was removed from one part of the churchyard to another, sixty yards distant, and was undoubtedly the oldest tree that has yet been transplanted. The trunk was split by lightning about the middle of the eighteenth century, during a storm which destroyed the steeple of the church. In consequence of the injury received, the trunk assumed a horizontal position, and in the process of replanting the tree was restored to a comparatively erect position.

Probably the most curious thing connected with yew trees is the way in which they have been cut to resemble some animal or other object. The ones at Bedfont, shown in our engraving, are most interesting. Bedfont lies near London on the high road and is equidistant between Hounslow and Staines. The primitive air of the place would hardly lead one to believe that it is within thirteen miles of the great metropolis. The quaintness of its appearance is increased by its little Norman church with its wooden tower and dwarfed steeple and its pair of trim and formal yew trees cut into the shape of peacocks, with the date 1704, and the initials of the church wardens of that time still legible in the cropped foliage. The local tradition is that the peacocks represent satirically two sisters who lived at Bedfont, and who were so very haughty that they both refused the hand of some local magnate, who thus immortalized them as being "as proud as peacocks." This is, however, only a legend and stories of the same kind will be found everywhere in England where there is anything out of the ordinary. The two peacocks have been immortalized by Thomas Hood, who makes them the subject of one of the most serious of his poems. Pope, who must also have seen these quaint artificial ornaments, satirized them in the "Guardian." He gives a list of some fifteen or sixteen subjects cut in evergreens, from Adam and Eve and Noah's Ark down to Queen Elizabeth. Of course, such artificial trimming of the trees is opposed to all rules of good landscape gardening, but they are interesting as curiosities. We are indebted to the courtesy of the editor of The Gardeners' Magazine for obtaining the photograph for us.



YEW TREES CUT INTO THE SHAPE OF PEACOCKS, AT BEDFONT, ENG.—THE TREES BEAR THE DATE 1704.

Experiments on the Coloring Matters of Plants.

M. Tsvett gives an account to the Academie des Sciences of a series of experiments relating to the coloring matter of plants. When plant leaves are treated with a concentrated aqueous solution of resorcinol, made slightly alkaline by ammonium carbonate, the chloroplasts swell up and agglomerate, and various constituents of the cells are dissolved and liquefied, while the coloring matter collects in large oily drops, which coagulate at once if the resocin is washed out by glycerol or water. These green globules are called chloroglobin by the experimenter; they are insoluble in saline solutions, but swell up when treated by carbonate of potassium and other salts, and are altered in characted by the former. They are slowly decomposed by dilute acids. Like many of the proteids, the globules absorb and retain coloring matters such as methyl blue, magenta, etc. Chloroglobin swells up in solutions of the alkaline hypochlorites and is decolorized, the bleached substance giving indefinite results with the ordinary reactions for proteids. It dissolves in strong alcohol, and if the solution is agitated with benzine a green coloring matter, which is not affected by resorcinol, passes into the latter, and a yellow substance, which is liquefied by resorcinol, remains in the alcohol. In physico-chemical properties, chloroglobin resembles the proteids; its solubility in ether, carbon disulphide, etc., seems to be due to the chromophoric nucleus of the molecule. The chlorophyll and Icarotin (xanthophyll) are probably loosely associated with the proteid nucleus. Chloroglobin can be obtained in a very pure condition by extracting suitable leaves in strong alcohol, diluting to 20° and collecting the very fine precipitate by filtering through porcelain.

"WHERE the Day Changes" is an interesting article in the current SUPPLEMENT. It deals with the various day lines which have been proposed as the line of demarcation between the American day and the Asiatic day. The position of the day line in the Pacific Ocean differs, according to the various authorities, and they differ from the 180th meridian. The day line is not a straight line, but makes a number of turns at different places. The article contains a map showing positions assigned to day lines by different geographers.

Correspondence.

Grounding Interior Conduits.

To the Editor of the SCIENTIFIC AMERICAN:

As the National Board of Fire Underwriters rule that interior conduits "must have the metal of the conduit permanently and effectually grounded" seems to be either indifferently complied with or entirely disregarded, and as the subject, is carefully examined would, doubtless, lead to interesting and valuable conclusions, I would like to have an expression of opinion as to the reason for this requirement, how it can best be effectually accomplished and what is the end in view. Does the grounding of the neutral wire in the Edison 3-wire system have any bearing on the case? ALFRED W. WATKINS.

[The grounding of the metal of a conduit secures a burn-out when the insulation is injured so that the accident can be detected and immediately repaired. Otherwise a leak might set in, and great loss be caused. The grounding of the neutral in a 3-wire system has no connection with the underwriters rule.—ED.]

Center of Gravity of Locomotives.

To the Editor of the SCIENTIFIC AMERICAN:

Having read with much interest the description of tests made by the Rogers Locomotive Works, to determine center of gravity of I. C. Engine 639, I am curious to know whether the tests were made with a full or empty boiler.

It is evident that the point of center of gravity will be materially changed by these conditions: 50½ inches being less than the distance from rails to bottom of boiler and at least 70 inches of the 80 inches of boiler diameter in service being occupied by water.

The water also would make a shifting load and would always be heavier toward the low side of engine; for instance, the rocking motion incident to high speeds on curves, or uneven track, would cause a large amount of weight to be thrown to that side. Be this as it may however, the center of gravity of this engine is not higher than is entirely safe or practicable, as the performance of the engine goes to show, and engine 640, built by Brooks Locomotive Works, for same service, appears to be of a still higher type, and I am of the impression that boiler is still larger than that of engine 639.

Should be much pleased if you would inform me as to whether the test spoken of was made with boiler empty or filled with water as it would be in service.

GEO. L. TENNEY, Locomotive Engineer, I.C.R.R.
110 East Church Street, Champaign, Ills.

[The boiler at the time of the test was filled with water, and the engine was in working order. The test was made to establish, experimentally, the actual center of gravity of one of the modern supposedly high-center-of-gravity locomotives, and the result was, no doubt, surprising to many of our readers.—ED.]

Turret Arrangement and Guns.

To the Editor of the SCIENTIFIC AMERICAN:

The writer had shared the hope that the superposed turret might be found to have the balance of advantages in its favor. The greatest aggregate range of fire for eight 8-inch guns is found when two of their turrets are placed on those of the 12-inch guns, while the remaining four are mounted in two 'midship turrets set similarly to the amidship turrets of the "Brooklyn." We have then four (8-inch) fore and aft guns with an arc of fire of (approximately) 280° each—aggregating an equivalent of 1,120° for one gun (I use this anomalous expression to enable comparisons), and the four 'midship guns have arcs of 180° each—aggregating 720° for one gun. The total for this arrangement is 1,840°.

If arranged as in the "Iowa," the eight 8-inch guns have arcs of about 160° each—giving a total of 1,280°.

The comparative amounts of arcs of fire are thus in the ratio of 1,840 to 1,280, or as 23 to 16. This great advantage is something to be retained unless corresponding weakness can be established.

The superposed turrets offer the further advantage of making two more guns available in both column and line formation.

In case that one of our ships should have to fight with an antagonist on each broadside simultaneously, there would be strong probability that these enemies would be unequal (as between themselves) in their fighting power, or positional advantage, or both, so making it desirable to turn a heavier broadside upon one of them than upon the other. This probability minimizes the force of the only prudential argument that seems strongly urged in favor of the "Iowa's" arrangement of turrets.

To advance another—and perhaps new—suggestion—suppose that the new 7-inch rapid fire guns should be placed in the superposed turrets, and at the same time the decreased weight of forward guns and turrets should enable the placing of somewhat larger turrets and guns amidships, say 9 inch guns. Would not such a battery be more powerful than any yet proposed? Also, why should we not build either 8 inch or 9-inch guns on the rapid fire plan, when Germany is arming her newer battleships with rapid firers of 9·45-inch for their heaviest calibers?

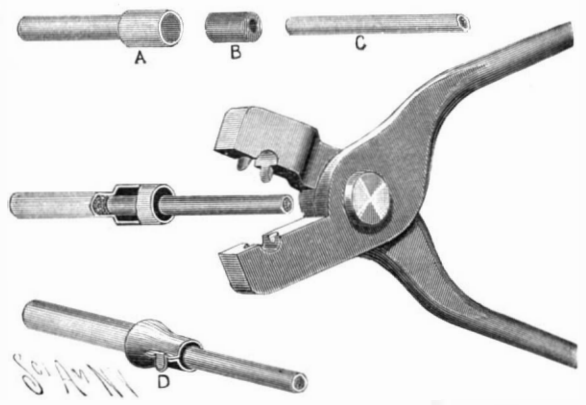
Since our "Brooklyn" carries eight 8-inch guns—with high speed—it seems unworthy of our "California" class of cruisers, to arm them with but four 8-inch guns. Why not four 9-inch guns and 'midship turrets for four 7-inch (all rapid fire)? J. E. CUTTER.

Riverside, California, May 7, 1900.

A WATERPROOF DETONATOR FOR MINES.

It is of prime importance that the blasting material used in mines should be the best obtainable and that the caps especially should be perfect. Many a miner has lost his life by drilling into holes which have missed fire because the detonator was not absolutely waterproof. A fuse waterproof detonator has been invented by Arthur S. Williamson, of Phoenix, British Columbia, Canada, which is designed to prevent the occurrence of accidents due to faulty construction.

The cap has a charge-chamber closed at its outer end and formed at its inner end with a pliable enlargement or thimble, *A* (Fig. 1). The open outer end of this thimble receives a fuse, *C*, which, as shown in Fig. 2, is projected through the thimble into the charge-chamber. Encircling the end of the fuse and fitting snugly in the thimble is a rubber-gasket, *B*. When the charge has been inserted in the chamber, *A*, and



WATERPROOF DETONATOR.

the fuse, *C*, and gasket, *B*, have been placed in position, the thimble is crimped so that the gasket is firmly compressed around the fuse, *C* (Fig. 3). Displacement of the parts is thereby rendered impossible. The cap is firmly held on the fuse; and the connection between the cap and fuse rendered absolutely waterproof.

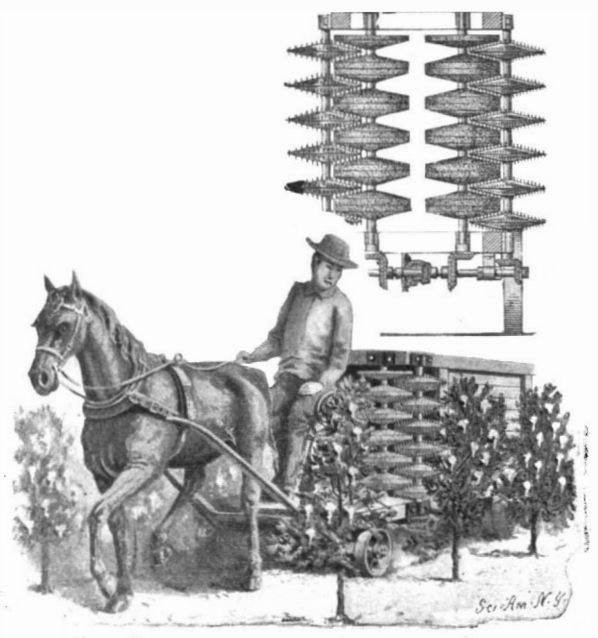
The tool for crimping the thimble, as shown in Fig. 2, consists of two pivoted jaws provided with matching semicircular cavities. The lower cavity has an opening at each side. These openings are designed to receive studs at the sides of the upper cavity. In crimping the cap, the thimble is laid in either cavity and the jaws forced together, which causes the thimble to be compressed, forming at each side a welt-like projection, which is subsequently bent over as shown at *D* (Fig. 3), as the studs in the upper jaw enter the corresponding openings in the lower jaw.

Caps are at present rendered waterproof usually by wrapping oiled paper about the fuse. The construction of Mr. Williamson evidently presents decided advantages over this very defective method of waterproofing the cap.

A MECHANICAL COTTON-PICKER.

An improved cotton-picker has been invented by William J. Dyer, of Shreveport, La., which is arranged to insure a clean and thorough removal of the bolls from high or low cotton bushes or plants, without tearing the fibers of the lint or the growing plant.

The machine, as our illustration shows, comprises a



AN IMPROVED COTTON-PICKING MACHINE.

horse-drawn, wheel-supported box, at the sides of the open front end of which vertical shafts are journaled, carrying picking-disks. Each picking-disk is formed with a sold core, whose top and bottom diverge from the edge to the center. Between these picker-shafts, two other vertical shafts are journaled, provided with brushes beveled at top and bottom to conform with the toothed picking-disks. On the lower ends of these four vertical shafts beveled pinions are carried which mesh with beveled gears on a forward transverse shaft geared with the traction-axle. The beveled gears are so proportioned with respect to the pinions that the picker-shafts will rotate at a lower rate of speed than the brush-shafts.

As the machine is drawn forward, the outer sides of the picking-disks pass between adjacent branches of the bushes, and the teeth remove the lint from the bolls. The cotton-lint thus picked is carried inward as the picker-shafts rotate, and swept off the disks by the brushes into the box.

In order to prevent the lint from flying sidewise and outward from the brushes and pickers, and to prevent clogging of the brushes and pickers by the lint, angularly disposed canvas flanges are arranged on the forward ends of the sides of the box, which flanges are provided with cut-out portions for the passage of the picking-disks.

Automobile News.

Rules forbidding high speed are being enforced in Paris, and there are an average of twenty arrests per day. There is now no place in France where automobiles can be driven beyond a reasonable pace. Scores of serious accidents in France have invited the introduction of drastic measures. In the race from Paris to Roubaix, the winner averaged 42 miles an hour and in going down hill it is said that he much exceeded this figure.

A paper forming part of the "Transactions" of the American Institute of Electric Engineers, and written by Messrs. G. F. Sever and R. A. Fleiss, gives the results of an investigation on certain horse and electric vans. Their average load throughout the day is 500 pounds and the average draw bar pull at seven miles per hour is 60 pounds per ton on coblestones; on asphalt, 40 pounds. The van tested weighed 1,300 pounds and its horse 1,105. The average daily work of a horse in such service is 16·5 miles at 50 pounds per ton at seven miles per hour, while the cost of horse, van, and attendance is $3.64 per day, or 17·4 cents per ton mile. If a second horse is kept these figures respectively become $4.28 per day and 10·2 cents per ton mile. The electric delivery van shows an average consumption of 92 watt hours per ton mile. At 5 cents per kilowatt hour, the cost per pound—of parcels only—is 0·019 cents, as against 0·020 cents for horse service. Depreciation is not taken into account.

Mr. J. H. A. Macdonald, Lord Justice Clerk of Scotland, and Brigadier of the Fort Brigade, recently read a paper before the Automobile Club, in London, upon the question of military motor cars. He dwelt at great length upon the numerous annoyances, dangers, and delays which surrounded animal transport trains and went to great length to show how much valuable time might be saved, and animal suffering avoided, were a military motor transport service inaugurated. He felt convinced himself that military motor cars would be a powerful adjunct to an army. In speaking of the motor that would most coincide with his ideas, he inclined to the opinion that heavy oil producing steam in the case of road trains and heavy oil as a propelling force for motors of the self-propelled wagon would be found the most suitable. He also remarked that much could be done in the matter of motor-propelled armored vehicles for strategic movements in countries possessing well made roads. He urged the English manufacturers not to wait for the War Office, but to work on their own responsibility and produce road motors and engines of the class that are so urgently required.

The annual Belgian Automobile Exposition, which closed the 8th of April, was held at Brussels in a large hall in the center of the city. The national industry was largely represented by the firms Gobron-Brillie, the German works, the Pieper, Deschamps, and other Belgian companies. The French section was represented by the Jenatzy Company, the Peugeot works and several others. An arrangement was made by which the workmen of the different automobile factories made a visit to the exposition under the guidance of the superintendents, and a number of students were admitted, accompanied by their professors. In a short time the city of Brussels will have a public automobile service. The vehicle used will be a type of vehicle of six places, this being of German make. It is provided with a motor of the Phenix type, giving six horse power. The tariff asked for the hire of these vehicles is $1 per hour for two persons, with an additional 40 cents for each extra person, the maximum rate for six persons being $2.20; for several hours at a time the rate is reduced to $2 per hour. It is expected that the system will prove a financial success.

SOME PACIFIC SHARKS AND ACCOMPANYING FISHES.

BY PROF. CHAS. FRED'K HOLDER.

The coast of California abounds in many different kinds of sharks, from the small Port Jackson variety to the giant bone shark, but so far as known fatalities from this cause have not been reported. Of all the sharks seen here the bone shark, or basking shark, is the most interesting, and the least common, being found in greatest numbers in the vicinity of Monterey, where at certain seasons of the year they are seen lying five or six miles off shore, at the surface, when they can be approached without difficulty. So valuable are these sharks for their oil that a company was formed among the Japanese for their capture, but a number of fatalities dampened the ardor of the men. One shark was apparently killed, and two boats had fastened to it to tow it in when it began to thrash about, completely wrecking the boats and killing several of the men, the others nearly dying of exposure in clinging to the wreckage before they were rescued. This shark attains an undoubted length of forty or fifty feet, but the average specimen is the north Pacific is not over thirty feet in length. Its teeth are small, the gill openings enormous, and its food is composed of very small animals. This shark is a northern form, and comparatively little is known concerning its habits. It is supposed that it breeds in deep water, as its young have never been seen. In the last century this shark was so common on the New England coast that there was an established fishery, and fishes of enormous size were taken for their oil. They were always found lying upon the surface, hence the popular name, basking shark.

The large shark found around the Californian islands is commonly known as the white oil shark, and by some the sand shark. It attains a length of nine or ten feet, and being of considerable bulk, presents a formidable appearance in the water when swimming about. Such a shark weighs from two hundred and fifty to three hundred pounds. It is provided with several rows of sharp teeth, and could make a desperate fight; but an instance of its attacking a human being has never been known. A photograph of a large specimen is shown in the accompanying illustration; it was captured at Santa Catalina Islands, Cal.

The most characteristic shark of these waters is the hammerhead Zygenid Sphyrna, its head being produced into a perfect hammer, giving the animal a most savage appearance. These sharks are extremely powerful, well illustrated by the maneuvers of an individual taken by me. In its rushes the fish nearly dragged the light boat under water, and was only stopped in its seaward rush after five boats had fastened to it. It towed my own boat with one man rowing against it and four others pulling at the top of their speed; even then we were nearly an hour dragging it into the bay where it made a vigorous resistance. This shark had six or seven remoras, Remora remora, clinging to it when hauled upon the beach.

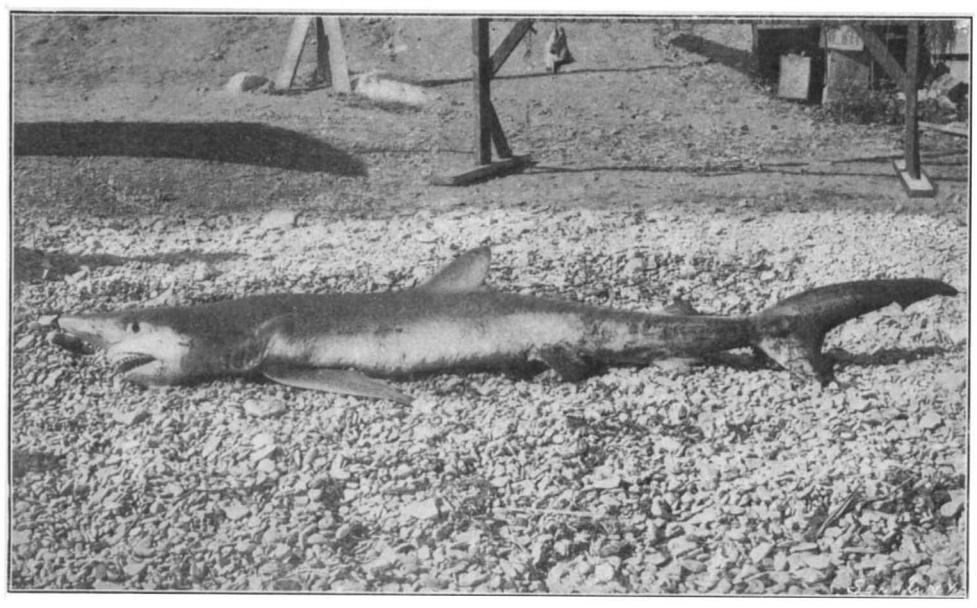
Off the coast of California certain sharks apparently affect certain localities. Thus in water four or five hundred feet in depth, a mile or two east of Avalon Bay, the dredg comes up filled with a small cat shark, Catulus xaniurus, about two feet in length, several of which were kept alive in the zoölogical station. Another interesting shark common here is Catulus uter, of a dark brown color marbled with dark spots, its head very flat. A small dark grey shark, the California dog shark, Galeus californicus, is common along shore with the leopard-shark, Triakis semifaciatum, not however, to be confused with the great leopard or tiger shark of southern waters. It is very abundant in the narrow bay known as Catalina Harbor, on the west side of the island of that name, where it schools in water a few inches in depth in July and August. In this bay with the above is found the oil shark, Galeorhinus zyopterus. In the summer months it can be seen here moving about in the muddy water within two or three feet of the shore, and in such shallow water its dorsal fin is fully exposed. The largest specimen I have taken here was six feet in length and weighed sixty-three pounds. This shark is highly valued by the Chinese who take its oil and fins, the latter being made into gelatine for soup.

One of the fiercest sharks is the Tigrone, or tiger shark, Galeocendo tigrinus, common in many seas and occasionally observed at San Diego. It is a giant of the tribe, individuals having been seen measuring thirty feet in length. As its name suggests, it is marked with spots over the entire surface, giving it a striking appearance. The strength of these monsters is marvelous. In attempting to take one in Florida, to obtain the skin, the fish towed my boat with such force that it was impossible to bring it alongside. Finally as we were going out of the channel an eight-oared barge intercepted us and threw us a rope, and ten men pulled against the shark but could not stop it; ultimately the tug of war ended by the breaking of the rope.

The great blue shark, Prionace glauca, is seen, though rarely, on the Californian coast, its color, a light bluish-gray, making it easily recognized. I have observed but one specimen in Southern California, that being brought into Avalon bay in 1898. It is a large powerful creature. The bay shark, Carcharhinus milberti, is often seen off San Diego, and is the "maneater" of the region, seemingly very similar to the C. lamia of Florida waters, though the shark has never been known to attack any one on the Californian coast. In appearance it is a savage creature, with its rounded head and enormous mouth, the latter filled with rows of large teeth.

WHITE OIL SHARK.

The term maneater is applied to several sharks, but it properly belongs to Carcharodon carcharias, the white or maneater shark of nearly all seas. It attains a length of thirty, possibly more feet. A specimen in the British Museum is twenty-five feet in length. One caught near Australia, which was thirty feet long, had devoured an entire horse. The largest specimen ever seen in California waters was caught at Sorquel; its length was thirty feet, and it had just dined on a sea lion which weighed one hundred pounds.



SOME PACIFIC COAST SHARKS—SHORT NOSE SHARK.

The dog fishes are represented by Squalus sucklii, easily recognized by the dorsal spines. Another spined shark is the bull head, Gyropleurodus francisci, a sluggish creature two or three feet in length, common among the rocks along shore but rarely seen during the day.

Nearly all sharks of large size are accompanied by one or more attendants, either remoras, "sucking fishes," or the pilot fishes, or both. The remora is a large-mouthed dark-colored fish with a remarkable sucking disk on top of the head, really a modification of the spinous dorsal fin. It is made up of a series of cartilaginous plates, which are placed transversely, and are movable and serrated on the free edges. The fish follows sharks and when tired attaches itself by the sucking disk and is thus towed along. I have seen half a dozen remoras clinging to the sides of a large shark, looking like gigantic leaches. I have also observed them on turtles and the large porgy in the Gulf of Mexico. The one common on the Californian coast, is Remora remora, while another, Echeneis naucrates, recognized by white stripes on the sides, is often seen on large sharks off the islands. With many sharks is found the young of the so-called pilot fish, Naucrates ductor. Those seen with sharks are three or four inches in length, easily distinguished by their bluish color and pronounced vertical stripes. The young Seriola zonata has a similar habit. Those observed by me were always playing about the head of the shark, or swimming beneath it, darting out at any foreign object as though to examine it. This habit has given rise to the legend that the fishes pilot the sharks to their prey; but the scent of sharks is very acute, and the pilots merely dart at bait because they possibly see it quicker than the shark, and being timid, they are continually venturing forth and darting back, easily conveying the impression that they are urging their protector on. The pilots and remoras take the crumbs from their hosts' table as their share.

Archæological News.

The yield of the ruins around Mugheir or Ur of the Chaldees in Babylonia will be deposited with the Smithsonian Institution at Washington.

Dr. A. M. Stein, Registrar of the Punjab University, has applied for and obtained the permission of the government of India, and also that of the Chinese government, to explore Khotan, in Chinese Turkestan, this summer. This is to be done for the purpose of scientific investigations.

The Quarterly Statement of the Palestine Exploration Fund contains a minute account of the life of the country women of Palestine, which is particularly interesting as adducing facts to show that the Canaanite at the time of Abraham and Ruth has been transformed with slight changes into the modern Fellah.

The American school for classical studies in Rome has just issued a circular outlining its programme of work for the ensuing year. The resident staff will consist of the director, Prof. Richard Norton, and Prof. Francis W. Kelsey. Prof. Norton will give regular courses in ancient archæology, art and topography, and monuments of ancient Rome. Prof. Kelsey's course will be on Roman architecture and Latin epigraphy. It is expected that other archæologists will give short courses, including Prof. Mau on "Pompeii and Herculaneum," and Prof. Orazio Marucchi on "Roman Numismatics," and others. The larger part of these lectures will be given in the field or in museums, and much of the time will be devoted to excursions from Rome to Naples and other places and will include an annual excursion to Greece. Only those who are specially qualified are admitted to the school.

The Current Supplement.

The current SUPPLEMENT, No. 1273, is of unusual interest. The "Engines and Boilers of the 'Deutschland'" describes and illustrates the six-cylinder quadruple expansion engines of 33,000 horse power and the boilers. "Some Useful Photographic Formulæ" is a choice collection of receipts. "Regulations Concerning the Prize Offered by the Aero Club" gives in full all of the details of this important competition for a $20,000 prize. "Where the Day Changes" is an interesting article by Dr. A. M. W. Downing, and is accompanied by a map. The usual Trade Suggestions from the United States Consuls, Trade Notes and Receipts, and Selected Formulæ are published.

Contents.

(Illustrated articles are marked with an asterisk.)

Air pump, electric* 324
Airship, Von Zeppelin's* 325
Automobile news 330
Borax industry, California* ..321, 325
Canal, Sault, power* 328
Cape Nome emigration 323
Car, shouldering* 324
Chemistry, modern needs of 322
Conduits, interior 330
Cotton picker* 330
Detonator, waterproof 330
Dunes of Gascony* 324
Engineering notes 327
Heavens in June 323
Inventions, index of 332
Inventions recently patented 332
Locomotives, center of gravity of 330
Oranges, seedless 326
Paris Exposition notes 327
Plants, coloring matter of 329
Postal service, English 322
Proposal, presumptuous 322
Science notes 327
Sharks, Pacific* 331
Shouldering car* 324
Supplement, current 331
Textile manufacture in the South 322
Tunnel, rapid transit 322
Turret arrangement and guns 330
Yew tree* 329

RECENTLY PATENTED INVENTIONS.

Bicycle-Appliances.

HANDLE-BAR.—JOHN RYAN and CHARLES OTIS, Manhattan, New York city. The invention provides a means for adjusting the handle-bar without affecting the position of the front wheel, until one of the handle-bars strikes or is over the upper main tube, and the other handle extends forwardly over the wheel, thereby enabling bicycles to be packed closely side by side, and to be trundled along without taking up much room.

DRIVING CHAIN COVER.—HORACE W. DOVER, Northampton, England. The inventor's object has been to provide a neat chain-cover for the driving-gear of bicycles, motor-cycles, and the like, which cover will prevent the skirt or trousers of the rider from becoming entangled with the chain. The cover has a sheet-metal frame, formed of superposed metal strips of transversely-curved section, riveted together and clamping between them the intervening flanges of a panel inclosing one side of the frame. The detachable end-cap has a rigid U-shaped rim-frame whose ends are designed to slide between the members of the cover-frame, thereby removably locking the frame of the chain-cover on its supporting bracket.

Electrical Apparatus.

GROUND-PLUG FOR ELECTRICAL SWITCH-BOARDS.—WALLACE I. STOCKDON, Orange, Va. When properly applied to a switchboard to ground the main circuit, this plug will operate an audible signal independently of the main electrical circuit and will continue to sound as long as the plug is in place, so that the operator will be notified when through with a line and will be certain to remove the plug and thus avoid the grounding of a wire except when desired.

CENTRIFUGAL PUMP.—SAMUEL MATTSON, Brooklyn, New York city. The piston of the pump with its inwardly-projecting hub, is mounted to revolve in the cylinder. The piston has a series of pockets, each provided with a curved bottom and an outlet-opening, the outlet-openings being in the rear wall of the piston, near the periphery. In the front wall of the piston is an inlet opening registering with the inlet-opening of the cylinder and communicating with all the pockets. The division walls of the pockets are reduced on curved lines extending from the front wall to the hub of the piston. The pump cannot be clogged by stones which have passed the piston.

MARINE BOILER.—HARRY LAWSON, Jersey City, N. J. The boiler comprises a shell, within which is a return-flue. Spaced mud-drums extend longitudinally below the shell, and between the mud-drums is a grate. Water-return circulating pipes connect the ends of the mud-drums with the shell. Sets of tubes extend from the mud-drums to the shell between the end circulating-pipes, the pipes and tubes forming a fire-box with the grate. A combustion-chamber at one end of the fire-box extends over the corresponding end of the return-flue. Means are provided for holding the return-flue in position within the shell. Worn-out tubes can be readily removed without disturbing the general construction of the shell or drums.

ENGINE.—PAUL O. E. BOUDREAUX, Theriot, La. The engine is an improvement in steam and air motors. It comprises essentially a shaft having a wheel furnished with sets of alternating teeth. Cylinders are provided, arranged in pairs, one pair corresponding with each wheel. Pistons moving in the cylinders, have stems or rods engaging the teeth of the wheel. Valves control the passage of the motive agent.

Mechanical Devices.

WASHING-MACHINE. — SAMUEL PATTERSON, Wilkes-Barre, Penn. This clothes-washing machine comprises a body in which a presser, a rubber, and a rod are vertically and horizontally movable. A swinging connection is provided for the rod, presser, and rubber. A pin extends from the reciprocating rod into a slot in an actuating-bar; and a crank has its wrist-pin engaging a slot in the bar. A gearing operates the crank. The presser and rubber can be removed whenever desired. By turning the crank the actuating-bar is reciprocated, thereby operating the presser and rubber.

BASKET-MACHINE.—WILLIAM JACKSON, Traverse City, Mich. The invention relates to a basket-form for basket-making machines, which form is held and turned so as to present all sides to the work. A stub shaft is mounted fast on the frame, and on the stub-shaft a sleeve is mounted to turn, having a square portion on which the sleeve slides and with which it turns. A brake-strap is provided for the sleeve. Two rollers are attached to the frame and engage the basket-form at opposite sides of the axis of the sleeve. The basket-form is placed beneath the staple-driving mechanism, so that work can be placed on the form. The form is turned around in time with the movements of the driving mechanism, so that the several parts of the basket can be fastened together.

COMBINATION METAL-WORKING MACHINE.—SAMUEL J. HUNGERFORD, Farnham, Quebec, Canada. The inventor combines a motor, a lathe, and a drill, with the object of economizing space and rendering the machine portable. The combined machine is cheap in its construction and is ready for instant service in any place where steam or other source of power is available. It occupies less floor-space than three separate machines, and requires less than the usual amount of shafting and belting. The machine is especially designed for use in railway-roundhouses, factories, mills, ships, and the like.

Railway-Contrivances.

SWITCH-LOCK.—LUTHER N. WYATT, Lexington, Ky. The purpose of the invention is to provide a device for throwing and simultaneously locking switches, the arrangement being such that the switches cannot be disturbed except through the medium of the regularly-provided lever. A stationary casing is used, formed with spaced shoulders, and recesses adjacent to the shoulders. A switch-bar extension slides through the casing, and a latch is pivoted between its ends on the extension and is slidable with the latter through the casing. This latch is formed with heads adapted to enter the recesses in the casing and is of such length that one head will engage with a shoulder when the other head engages an opposite recess. The latch can be rocked, and the extension slid in the casing.

CAR-COUPLING.—FRANK J. PENNINGER, 290 Tivernois Avenue, Detroit, Mich. The invention provides an uncoupling device operated on the hinge principle and adapted for uncoupling all forms of Master Car-Builder's couplers, which ordinarily require a special uncoupling device. The inventor employs a special spring construction which so operates upon the uncoupling-shaft as to hold the crank-lever in the desired position, either coupled or uncoupled, as well as a spring connection between the crank-arm and the coupling device, which will yield in the direction of the coupler when the pulling strain is very excessive or when such strain would tend to break an unyielding connection.

SIGN FOR STREET-CARS.—LOUIS HASSELBUSCH, Philadelphia, Penn. The invention provides revoluble or changeable signs to be placed on the roofs of street-cars to indicate the destination or direction of the car. The hood employed can be readily removed to change the signs, and the signs can be shifted from the platform or interior of the vehicle and locked in place. At night the signs are illuminated by the light radiating from the clear story or interior of the car, thus dispensing with an especial lamp.

Miscellaneous Inventions.

WICK.—HENTIR SARAFIAN and Commodore D. RUNDELL, 621 Broadway, Manhattan, New York city. To each of these inventors a patent has been granted for a wick which will be incombustible, which will not char or clog, and which will require no trimming or adjustment. The wick has its body portion made of woven cotton cloth, while the end which carries the flame is surmounted with a refractory or incombustible material, which does not burn away or require trimming.

CRANBERRY-GATHERER.—WILLIAM B. WATERS, Manomet, Mass. The device consists of a pronged scoop provided with a screen and a handle. The prongs raise the vines or bushes sufficiently to prevent scooping up a great amount of dirt, as the berries are stripped by the prongs from the branches. When a quantity of berries has accumulated, the leaves, stems, and other refuse are picked out; and when this is done, loose dirt is sifted out by means of the screen.

GATE.—MARION B. SMITH, Plain City, Ohio. The construction of the gate is such that there is no strain upon the posts when the gate is closed. Before it can be opened the gate must be raised, thus enabling it to clear obstructions. It can be dropped whenever desired, so that when it is partially opened it can be held in position by causing its front end to engage with the ground.

MITER-BOX.—MARCUS A. K. SHOTWELL, El Paso, Tex. The miter-box comprises a base-block, on the upper side of which a metal plate is located, and in the base below the plate, a turn-table is mounted to rotate on ball-bearings. A saw-guide is carried by the table, and a detent or dog engages the table. Angular adjustment can be effected while the saw is in the guide-cylinders; for, by moving the dog out of engagement with the turn-table, the turn-table can be rotated by the force exerted laterally on the saw. Thus the box can be adjusted to guide the saw at any desired angle.

FIREPROOF PLASTER-BOARD.—PATRICK RYAN, Manhattan, New York city. This invention relates to fireproof covering for the sides and ceilings of rooms. The covering is in the form of a rectangularly-edged board formed of alternate layers of fireproof-paper; and a suitable plaster coated thereon, when applied by nailing the boards in place, affords a smooth, continuous covering for the joists and studding of a room, is non-combustible, and impervious to air, dust, or vermin.

LETTERING DEVICE.—LUCIAN RUST, Cleveland, Ohio. The object of the invention is to produce a simple and cheaply-manufactured device which can be used for accurately laying out letters upon drawings. The device consists of two similar parts, a scale member, and a ruler member. The scale member has one or more scales laid out on its face, each scale being designed for producing a certain character or letter.

KILN FURNACE, OR OVEN FOR CERAMICS.—ERNST K. B. ROHHARDT and FRIEDRICH A. TEIFKE, Uetersen-Moorrege, Germany. In this oven the hot fire-gases give up their greatest heat to the bottom of a chamber over which the heavy, cold air is collected. They then pass to the back of the chamber along the sides, front, and top of the chamber in order to escape through an uptake, after having given up their available heat. The burning of the articles in the chamber will thus be very clean; and the air may be regulated so as to allow for the greater or less amount of moisture contained in the goods to be burned.

FENCE-WIRE STRINGER. — JOHN NOBLE, Edwards, N. Y. This invention provides a device, by means of which fence-wire can be strung or fed from a reel as needed, upon any character of ground, the services of only a single operator being required. The device is so constructed that it can be operated wherever a man can find passage, and that it can be employed for rereeling or rewinding wire of any kind.

TRAP.—CHRIS W. NELSON, Neenah, Wis. The trap is especially designed for kitchen-sinks, lavatories, and plumbing fixtures and is arranged to prevent dry siphoning and to permit the trap to be cleaned. Dry siphoning is obviated by the use of a partition in the trap-chamber, which partition is perforated above its lower end. The trap can be cleaned by removing the screw-plugs from the heads.

Designs.

PILLOW-TOP.—RAFFAELLO ASTARITA, Manhattan, New York city. The designer has conceived a very tasteful and artistic pillow-top, in which violets and ribbons have been effectively combined.

OFFICE-CASTER — HOSMER H. HENDEE, Wilber, Neb. The caster is provided with receptacles for pins, pens, postage stamps, and articles generally used in offices and counting-houses.

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References to former articles or answers should give date of paper and page or number of question.

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(7891) J. T. M. asks for full directions for making a jump spark coil for four cells of Fuller batteries. A. The materials for your coil will be 4 pounds No. 14 A. W. G. cotton covered copper magnet wire, and perhaps a pound of No. 14 soft iron wire. Two binding posts. Two ends for the coil of hard wood of some sort with an inch hole through their centers. Some brown paper which may well be paraffined for insulation, in strips about ten and a half inches wide. For a coil ten inches long, cut the iron wire into pieces twelve inches long, heat them red hot and allow to cool slowly. Straighten the pieces carefully, and make a bundle which will fill the holes in the head tight. The two hardwood heads driven upon the ends of the bundle of wire form the ends of the coil. Leave a clear space of ten inches for winding the wire between the heads. Make a hole in the head with an awl of the size of the wire, and bring the end of the wire out through this hole before beginning to wind the coil. Cover the core with a layer of paraffined paper. Wind one layer of magnet wire upon the core, tightly and evenly. Cover this layer with the paper and proceed in the same way with each succeeding layer. The end of the wire after the spool is filled is to be passed through a hole in the head, the coil thus finished may be secured upon a board as a base, and the binding posts fastened to the base. With these the ends of the wire are to be connected. The coil is then ready for use.

(7892) C. D. C. asks: 1. Is it not true that scientists contend that lightning has a small amperage and an immense voltage? A. Yes. 2. What caused them to arrive at such conclusions? A. Measurements of the voltage required to force a spark across air gaps prove the high voltage of a spark. The small amount of energy in such a discharge proves its low amperage. 3. Are any instruments made for such investigations? A. Yes, electrometers. 4. Why is it not advisable to turn down high bars or smooth rough places in a commutator with emery? A. To avoid the possibility of imbedding particles of copper in the insulation between the bars and thus forming a short circuit. 5. Is there any method of calculating the number of lines of force in a magnet or solenoid? A. See Thompson's "Elementary Lessons in Electricity and Magnetism," price $1.40 by mail.

(7893) M. G. de M. writes: 1. I have received from Europe a Wimshurst electro static machine. The plates are of ebonite but they arrived warped and they touched themselves in the rotation. The machine does not produce any electricity probably due to this and the great dampness of the climate. Is there any manner of making the plates again even by softening the ebonite. A. The plates of ebonite can be flattened by softening them by heat and pressing them flat between two plane surfaces while cooling. To secure dryness, it will be necessary to inclose the moving parts of the machine in a case and to keep calcium chloride in the case to absorb the moisture. 2. Can you also tell me the theory of this machine that I suppose is like the replenisher of Lord Kelvin. A. The theory of the Wimshurst machine is given in Thompson's "Elementary Lessons in Electricity and Magnetism," price $1.40 by mail.

(7894) J. H. L. says: I wish to make pads of my letter paper. How shall I make the gum for top and side so that it will not tear the paper when a sheet is removed and also not be perceptable on the edge of sheet, which must be used on typewriter. A. For each 50 pounds of dry glue allow 9 pounds of glycerine. Soak the glue for 30 minutes and heat until it becomes liquefied. Then add the glycerine. If it proves to be too thick add water, colored with aniline if desired.

(7895) T. J. G. asks what you regard as a good, permanent, "dry deodorizer," furnishing as well a fragrance to the atmosphere of airtight and sound-proof telephone booths? A. Use charcoal. It can be baked to restore its original absorbent qualities. Be careful not to ignite it in baking. If a perfume is required, use any agreeable gum or resin, or a perfume powder.

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HAND RAILING SIMPLIFIED. Sectorian System by an Architect. Edited and revised by Fred T. Hodgson. 16mo. Pp. 52. Price $1.

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THE COMPOUND ENGINE. By F. R. Low. New York: Power Publishing Company. 1900. 12mo., pamphlet. Price 50 cents.

The editor of Power has done a wise thing in issuing this little monograph on compound engines. It is a subject which necessitates great clearness of expression and which must be illustrated by very clear diagrams. This result has been obtained admirably in the present book, which is illustrated with many diagrams. We commend it to all those who wish to get a thorough understanding of the compound engine.

THE CALCULATIONS OF ANALYTICAL CHEMISTRY. By Edmund H. Miller, Ph.D. New York: The Macmillan Company. 1900. 8vo. Pp. 183. Price $1.50.

Chemical calculations are fascinating, and there is little real difficulty in working any problem if the rules are well understood. The volume before us is an admirable text-book, in which new methods are described. There are many examples given, all of which can be solved by arithmetic or algebra. The book is rather more extensive than any we remember to have seen.

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INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending

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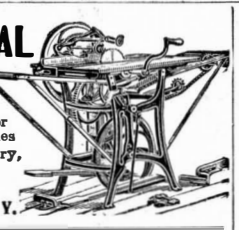
AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Advertising wagon, W. Uting..... 649,622
Alarm. See Pyrotechnic alarm.
Alkali and halogen gas, manufacturing caustic, C. E. Acker..... 649,565
Amalgamator, A. Z. Baldenebro..... 649,796
Aquarium, G. W. Sues..... 649,494
Arbor attachment for holding work, C. H. Bartlett..... 649,571
Armature cores, spacing rib or block for, J. A. Foshag..... 649,574
Awning, L. Wolf..... 649,789
Axle collar washer, G. W. Hedrick..... 649,603
Axle lubricator, J. B. Decker..... 649,819
Axles, forging car, C. M. Wales..... 649,497
Back pedaling brake, V. E. Doremus..... 649,631
Bait casting hook, L. F. Crosby..... 649,508
Bank vault, J. T. Hough..... 649,456
Bar or wire cutting machine, C. W. Levalley..... 649,850
Barrel lifter, J. F. Reilly..... 649,480
Basket, fruit, G. Miller..... 649,467
Batteries and regenerating elements thereof, operating primary, H. K. Hess et al..... 649,840
Batteries and regenerating elements thereof, operating two liquid primary, H. K. Hess et al..... 649,841
Battery. See Storage battery.
Battery compound, H. Blumenberg, Jr....649,653, 649,654
Bearing, ball, W. J. Brewer..... 649,802
Beater or mixer, W. H. Spanier..... 649,683
Beer, etc., in glasses, tankards, etc., apparatus for indicating and checking supply of, L. Beyer..... 649,531
Bicycle attachment, J. E. O'Neill..... 649,746
Bicycle gear, P. J. Scharbach..... 649,878
Bicycle support, P. Goldsmith..... 649,663
Bicycles, etc., driving mechanism for, J. C. Busche..... 649,806
Bicycles, etc., steering fork for, C. F. Harrington..... 649,691
Binder, paper, C. H. Stoelting..... 649,649
Binder, temporary, J. Bystrom..... 649,867
Binnacle and steering stand, W. T. Stanworth..... 649,771
Bit. See Drill bit.
Blotter device, rotary or revolving, W. R. Ripley..... 649,755
Boat, J. C. Nichol..... 649,525
Boat, dumping, W. S. Barney..... 649,427
Bobbin, E. E. Hendrick..... 649,638, 649,639
Boiler furnace, steam, W. R. Hines..... 649,664
Boot or shoe, rubber soled, G. F. Butterfield..... 649,434
Bottle, non-refillable, W. H. Boyington..... 649,801
Bottle, non-refillable, J. Reepmaker..... 649,752
Bottles, etc., closure for, E. Hoffman..... 649,453
Box made of a single piece, Laden & Ortelli..... 649,462
Bracket. See Lamp bracket. Shade bracket.
Bracket, C. F. Doebler..... 649,658
Braiding machine, A. B. Diss..... 649,688
Braiding machine, C. Schutz..... 649,618
Brake. See Back pedaling brake. Electric brake.
Brake beam, F. W. Coolbaugh..... 649,568
Brake beam, J. H. Hansen..... 649,891
Breeching, H. P. Quin..... 649,477
Brick machine, R. Anthony..... 649,792
Bridge, arch, D. B. Luten..... 649,643
Brush, J. C. Ludke..... 649,853
Brush, air, C. L. Burdick..... 649,430, 649,431
Bundle discharging mechanism, E. A. Johnston..... 649,731
Burner. See Hydrocarbon burner.
Button, collar, L. H. Brooks..... 649,656
Button, tack fastened, C. A. Bryant..... 649,886
Cable sprocket wheel, W. W. Willson..... 649,563
Calculating machine, J. Mallmann..... 649,522
Cannon, breech loading, E. Burkins..... 649,433
Cap, D. J. Cremen..... 649,815
Car attachment, railway, F. A. Baier..... 649,795
Car, convertible, Burger & Williams..... 649,804
Car coupling, P. A. McPeak..... 649,858
Car door, Carter & Davidson..... 649,810
Car door cleat and fastener, H. H. Burkhart..... 649,805
Car fender, etc., tram, W. Mattes..... 649,701
Car washing apparatus, railway, C. A. Wheeler..... 649,786
Carbon, electric light, J. F. Sanders..... 649,551
Carbureter, Carter & Zierlein..... 649,435
Carbureter, Verhagen & Van Gink..... 649,865
Carriage, motor, R. M. Gay..... 649,639
Carriage, motor, W. B. Mason..... 649,667
Cart, dumping, H. A. Dirkes..... 649,687
Casein, solid, W. A. Hall..... 649,690
Caster, furniture, G. D. Clark..... 649,506
Chance and game apparatus, T. H. Coker, Jr..... 649,814
Check holder, sales, S. Liebman..... 649,736
Chopper. See Food chopper.
Churn, W. Smith..... 649,557
Cigar making machine, E. Dubois..... 649,537

(Continued on page 333.)

WOOD or METAL Workers



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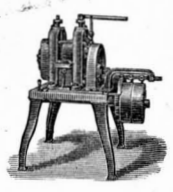

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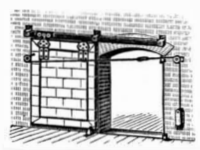

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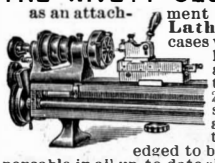

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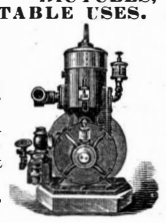

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Clasp for envlops, wrappers, boxes, etc., W. Schmidt 649,764
Cleaner. See Tube cleaner.
Cloak rack, revolving, E. Leger 649,734
Clock, electric, S. P. Thrasher 649,587
Clock, secondary electric, S. P. Thrasher..649,589, 649,591
Cloth cutter, R. Phillips 649,862
Clutch, McGloughlin & Lesperance 649,704
Clutch, spike pulling, F. Newnham 649,873
Coal cabinet, C. M. Nelsen 649,471
Cock or regulator, gas, G. W. Bishop 649,799
Coffin attachment, E. Miller 649,740
Coin controlled apparatus, U. Perrier 649,645
Coke oven, G. Hilgenstock 649,450
Coke oven doors, device for drawing up, G. Hilgenstock 649,451
Coke oven, externally heated, O. Ruppert 649,483
Comb cutting machine, H. H. Predmore 649,875
Confectionery making apparatus, T. V. Cox 649,569
Controller mechanism, A. E. Norris 649,644
Cooker, feed, J. W. Troutman 649,684
Cooler. See Milk cooler.
Cork puller, E. Walker 649,498
Cotton picker, W. Warmack 649,710
Couch, W. Vogler 649,780
Coupling. See Car coupling. Hydraulic coupling. Pump rod coupling. Steam coupling. Thill coupling. Windmill coupling. Wire coupling.
Crane, H. H. Hoke 649,578
Crate, folding, J. C. Erity 649,660
Crockery mold, J. Cook 649,888
Cup. See Paste cup.
Currying machine, L. C. Schneider 649,487
Curtain for cabinets, desks, etc., P. J. Pauly, Jr. 649,705
Curtain holder, W. L. Isbills 649,729
Curtain ring and holder, combined, A. Beulwitz .. 649,715
Cut out, E. Pettet 649,527
Cutter. See Cloth cutter.
Cyclometer guard, C. H. Eldon 649,570
Dental engine handpieces, shaft coupling for, R. F. Ludwig 649,642
Dental forceps, B. B. Mories 649,742
Dentist's mouth dilator, etc., J. A. W. Lundborg. 649,854
Dichlordiethylrhodamin and making same, sulfonated, H. Boedeker 649,716
Die head, J. P. Lavigne 649,733
Dinaphthylamin sulfo derivative and making same, Bammann & Vorster 649,714
Disinfecting apparatus, F. J. Mitchell 649,583
Displaying advertisements, etc., apparatus for, F. M. Johnson 649,459
Door, gram, E. Jacquemin 649,696
Draught equalizer, five-horse, H. Lenling 649,735
Draught regulator, G. H. Scharf 649,763
Drier. See Hair drier. Lumber drier.
Drying apparatus, C. R. Splivalo 649,648
Drill. See Rock drill.
Drill bit, F. Schrader 649,488
Dye and making same, blue basic, B. Homolka. 649,727, 649,728
Dyeing, R. E. Schmidt 649,486
Eggs, cleaning, D. D. & J. A. Wilson 649,652
Elastic wheel, M. T. Minogue 649,668
Electric brake. Steel & Nesbitt 649,620
Electric energy, controlling and distributing, F. W. Erickson 649,572
Electric light system, H. F. Roach 649,549
Electric machine brush holder, H. Sawyer 649,552
Electric meter, W. H. Pratt 649,707
Electric switch, F. Schwedtmann 649,554
Electric switch, F. L. Sessions 649,767
Electric traction, means to be employed in, M. J. Barreau 649,797
Electrical energy, apparatus for transmission of, N. Tesla 649,621
Electrolysis apparatus, A. E. Peyrusson 649,614
Elevator, F. K. Fassett 649,662
Elevator door, H. Bitner 649,505
Engine. See Explosion engine. Rotary engine. Traction engine.
Engine, W. C. Deibert 649,820
Engines, electrical igniter for gas, D. M. Tuttle .. 649,778
Engines, sparking igniter for explosive, C. E. Duryea 649,441
Envelop, interlocking return, T. M. Sherriff 649,768
Envelop, photographic mailing, J. Burton 649,627
Eraser, blackboard, G. F. De Forrest 649,599
Excavating and elevating apparatus, F. E. Allen 649,791
Exhibiting machine, J. Heissenberger 649,869
Exhibition card, F. Schmetz 649,485
Explosive, A. Luck 649,852
Explosive engine, Woodward & Barckdall 649,715
Extension table, F. Sutter 649,774
Eyelet, Saltzkorn & Nicolai 649,761
Farm gate, J. B. Engstrom 649,539
Faucet, J. Howes 659,457
Faucet, two way, W. H. Barrett 649,428
Feed water, etc., structure for cooling, Fischer & Klepetko 649,573
Fence clips, tongs for keying, F. Canfield 649,887
Fence machine, H. A. De Chenne 649,598
Fence machine, slat and wire, W. F. Seargeant .. 649,555
Fence post, L. K. Forsythe 649,830
Fence post, A. E. Roberts 649,756
Fence, wire, A. E. Roberts 649,863
Fence wire stretcher and tightener, J. M. Napier. 649,524
Fence, woven wire, J. B. Engstrom 649,827
Fender. See Car fender.
File wrapper and package fastener, F. C. Davis .. 649,816
Filter, O. Selg 649,490
Filter, cistern, G. Ritter 649,530
Firearms, safety mechanism for double action, H. M. Caldwell 649,809
Fire escape, C. A. Ives 649,458
Fire escape, J. T. Smith 649,769
Fire extinguisher, D. W. Diggs 649,657
Fire extinguisher, C. J. Zappert 649,564
Fish hook, C. Fredricks 649,510
Fishing net frame, J. G. Landman 649,581
Fixture, A. C. Fischer 649,634
Floral stand, A. Klokner 649,697
Flower holder, T. Payne 649,874
Fluid pressure press, R. Ruetschi 649,760
Flushing apparatus, E. J. McCulloch 649,670
Fly trap, A. Hammond 649,448
Food chopper, L. T. Snow 649,770
Forges, injector for portable, H. E. Parson 649,672
Forging press, J. P. Kelly 649,516, 649,517
Fork crown, tubular, W. H. Fauber 649,633
Furnace. See Boiler furnace.
Furnace, H. J. J. Charlier 649,567
Furnaces, apparatus for introducing air and steam into, S. B. Molony 649,611
Garment holder, F. L. Napier 649,584
Gas administering apparatus, A. W. Browne 649,717
Gas generating apparatus, acetylene, A. F. Chace 649,811
Gas generator, acetylene, T. C. Buddington 649,596
Gas generator, acetylene, A. F. Chace 649,812
Gas generator, acetylene, F. A. Feldkamp 649,442
Gas generator, acetylene, L. Mayhew 649,466
Gas generator, acetylene, W. Miller 649,610
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Gas lighting attachment, P. Bardot 649,426
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(Continued on page 334)

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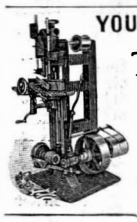

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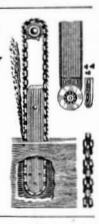

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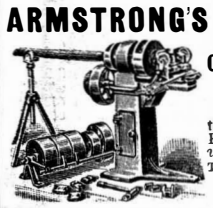

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PROPOSALS.

COMMISSION
NEW EAST RIVER BRIDGE,
City of New York.

NOTICE TO CONTRACTORS.

APRIL 19, 1900.

Bids will be received by the Commissioners of the New East River Bridge, at their office, at No. 258 Broadway, in the Borough of Manhattan, in the City of New York, at two o'clock in the afternoon of the **31st** DAY OF MAY, **1900,** endorsed "BID FOR CONSTRUCTION OF THE STEEL AND MASONRY APPROACH ON THE BROOKLYN SIDE OF THE NEW EAST RIVER BRIDGE," for furnishing the materials for and constructing the steel and masonry approach on the Brooklyn side of the New East River Bridge, in accordance with the proposed form of contract and the drawings and specifications therefor. All bids shall be enclosed in sealed envelopes, addressed to Lewis Nixon, President of the Board of Commissioners of the New East River Bridge, and presented to him on that day and at that hour at said office, and such bids will be opened in public meeting by the said Commissioners on that day at two o'clock in the afternoon.

Copies of the specifications and the general drawings for the work, with the proposed forms for the bid, bond and contract, may be seen, and further information will be given at the office of the Chief Engineer, No. 84 Broadway, Borough of Brooklyn, City of New York, on and after the 28th day of April, 1900.

The Commissioners require that all bidders shall carefully examine the specifications, drawings and proposed form of contract, in order that no question as to their meaning may arise hereafter. It must be distinctly understood that no changes in the quality of the materials or of the workmanship will be allowed, and that the specifications will be adhered to strictly.

The contract is to be completely performed within twelve months after the execution of the contract.

Bids will be made upon a form provided therefor, and only those bids will be considered which are complete, in proper form, comply with the requirements herein stated and are offered by parties of known reputation, experience and responsibility.

Each bidder will be required to deposit, with his bid, in the office of the Commissioners, a certified check for $6,000, payable to the order of Julian D. Fairchild, as Treasurer of the New East River Bridge Commissioners, as security for the execution by him of the contract and the giving of the required bond, if his bid is accepted, within two weeks after notice of the acceptance of his bid.

The Contractor will be required to give a bond in the penal sum of $200,000, in the form annexed to the proposed form of contract, with two approved surety companies doing business in the City of New York, conditioned for the prompt and faithful performance of the contract and its covenants and the work thereunder.

As by far the greater part of this work can be executed only by bridge establishments of the first class, bids will be received only from such parties as have the requisite plant and facilities, which have been in successful operation on work of similar character for at least one year. The bidders must be, in the opinion of the Commissioners, fully qualified both by experience and in appliances to execute work of this character and importance according to the highest standard of such work at the present time.

The Commissioners reserve the right to reject any and all of the bids offered, and to accept any bid offered.

LEWIS NIXON, *President.*

JAMES D. BELL, *Secretary.*

COMMISSION
NEW EAST RIVER BRIDGE,
City of New York.

NOTICE TO CONTRACTORS.

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Copies of the specifications and the general drawings for the work, with the proposed forms for the bid, bond and contract, may be seen, and further information will be given at the office of the Chief Engineer, No. 84 Broadway, Borough of Brooklyn, City of New York, on and after the 28th day of April, 1900.

The Commissioners require that all bidders shall carefully examine the specifications, drawings and proposed form of contract, in order that no question as to their meaning may arise hereafter. It must be distinctly understood that no changes in the quality of the materials or of the workmanship will be allowed, and that the specifications will be adhered to strictly.

The contract is to be completely performed within fifteen months after the execution of the contract.

Bids will be made upon a form provided therefor, and only those bids will be considered which are complete, in proper form, comply with the requirements herein stated and are offered by parties of known reputation, experience and responsibility.

Each bidder will be required to deposit, with his bid, in the office of the Commissioners, a certified check for $12,000 payable to the order of Julian D. Fairchild, as Treasurer of the New East River Bridge Commissioners, as security for the execution by him of the contract and the giving of the required bond, if his bid is accepted, within two weeks after notice of the acceptance of his bid.

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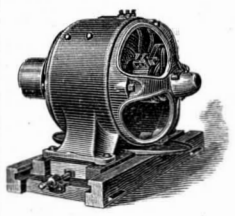

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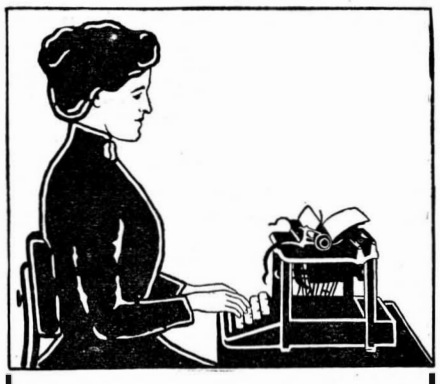

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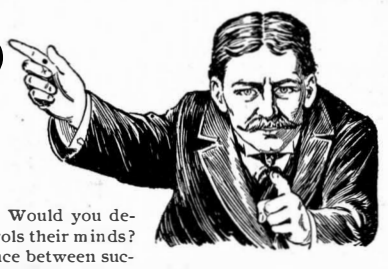

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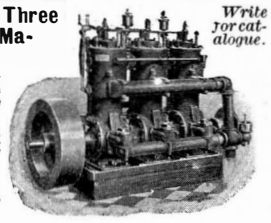

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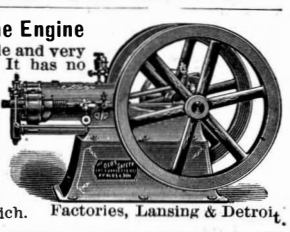

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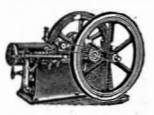

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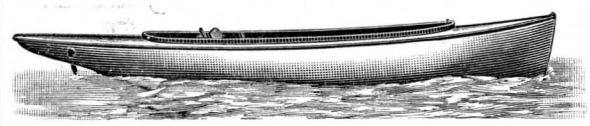

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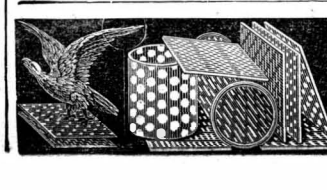

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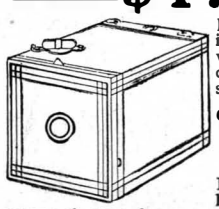

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Brownie Camera, for 2¼ x 2¼ pictures, - - - $1.00
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Send a dollar to your local Kodak dealer for a Brownie Camera. If there is no Kodak dealer in your town, send us a dollar and we will ship the camera promptly.

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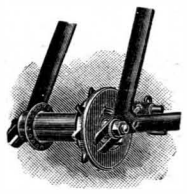

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OWNERS OF
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Messrs. BRADLEY PULVERIZER CO. EGYPT, PENN., August 25, 1899.

Gentlemen: Replying to your inquiry as to what we think of THE GRIFFIN MILL, we will say that the first Griffin Mill used in grinding Portland cement was erected in our Egypt works ten years ago, where it is still in operation. Since then, as from time to time we have built new works, we have equipped them all with Griffin Mills. We have now in operation at our several works, thirty-seven mills.

We know all about the grinding machinery used in the various cement works in this country, but think the Griffin Mill superior to any other for grinding Portland cement and the raw material from which it is made. What we think of the Griffin Mill is shown by the fact that within the last week we have given you an additional order for more mills.

Yours very truly, AMERICAN CEMENT CO.,
JOHN W. ECKERT, President.

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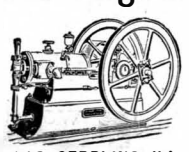

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